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e-Learning in the corporate sector: A case study in the oil and gas industry

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DECLARATION

This thesis contains no material which has been accepted for any other academic award at this or any other university.

To the best of my knowledge this thesis contains no material previously published by any other person except where due acknowledgment has been made.

Signed:

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ABSTRACT

This research examined the implementation of an e-learning tool at Apache Energy, an oil and gas company operating in Western Australia. The e-learning tool was developed to help facilitate an understanding of site safety at an oil and gas facility characterised by an increasingly contracted workforce. The study's research questions were formulated to describe and explain the implementation, looking particularly at relationships between the design of the e-learning tool, the way in which it was implemented, and the outcomes that emerged.

The study adopted an interpretive-case study approach focusing on 256 contractors who engaged with the e-learning tool at a dedicated e-learning centre in metropolitan Perth, Western Australia. Interviewing and detailed observation were the primary data collection methods used in the study.

In describing and explaining the implementation of the e-learning tool, the research found evidence to suggest that it achieved its desired outcomes. Further, the study noted widespread acceptance of the e-learning model. Contractors appreciated the self-paced and multimedia attributes of the e-learning experience, finding it a refreshing and empowering change to what they saw as the repetitive treadmill of safety inductions that characterises the oil and gas industry. However, there were some discrepancies between the design of the e-learning tool and its implementation, particularly in relation to the quality and level of social resources that were provided to support the tool. Tailoring the e-learning experience for individualised learning (e.g. scaffolding contractors with limited computer skills) is one of the key challenges for future implementations.

This study will interest training professionals and managers in VET and corporate settings who are considering adopting e-learning as an alternative or integrated education and training solution.

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OPERATIONAL DEFINITIONS

Apache Energy Contractors	Organisations or individuals that have entered into an agreement with Apache Energy to conduct work at one of its facilities.
Apache Energy e-learning tool	Software developed for the purposes of introducing employees and contactors into general safety principles and practices at Apache Energy, including its Permit to Work system.
Apache Energy e-learning centre	A dedicated learning facility located in metropolitan Perth Western Australia. The facility comprises of six computers all of which run the Apache Energy e-learning tool and an administrative/technical support function to assist contractors in engaging with the Apache Energy e-learning tool.
Apache Energy Safety Advisers	Apache Energy empoyees with responsibility for the maintenance of Apache Energy safety standards.
Australian Flexible Learning (AFL) Framework	The Australian Flexible Learning Framework provides the vocational and technical education (VTE) system with e-learning skills, professional development opportunities, products, resources and support networks to meet today's increasingly technology-driven learning environment. See http://www.flexiblelearning.net.au/flx/go/home/about

Blended learning	The combination of multiple approaches to learning. For example: self-paced, collaborative or inquiry-based study. Blended learning can be accomplished through the use of 'blended' virtual and physical resources. Examples include combinations of technology-based materials, face-to-face sessions and print materials. http://en.wikipedia.org/wiki/Blended_learning
e-Learning	A continuum of synchronous and asynchronous processes, which include computer-mediated learning, distributed learning networks, web-based learning, teaching aided learning, on-line learning and asynchronous learning networks. (O'Fathaigh, 2002, p.1).
Information and communication technologies (ICT)	Equipment, software and networks that enable publication, information dissemination, communication, collaboration, resource distribution, interactive teaching and learning and course integration.
Permit to Work	A signed statement by authorised persons that a job may be carried out given that stated precautions are understood and acknowledged. A Permit to Work is used to maintain a high level of safety in the operation and maintenance of operational facilities. The need for work permits is found primarily in non-routine work, likely to involve risk, or create hazards, which can adversely affect the facility and its personnel.
Vocational Education and Training (VET)	Post-compulsory education and training, excluding degree and higher level programs. VET provides occupational or work-related knowledge and skills. Alternative terms used internationally include technical and vocational education and training, vocational and technical education, and further education and training.

CHAPTER 1
Introduction

1.1 Introduction to the research study

This chapter introduces the research and provides some background to the study including its purpose and objectives. The chapter then outlines the significance of the study within the context of the current research agenda, particularly as this relates to corporate settings. The chapter closes with a brief overview of the organisation of the thesis.

The study was undertaken to describe and explain the implementation of an e-learning tool in the oil and gas industry, and seeks to contribute to the development of good practice e-learning by capturing and documenting the features of the implementation that worked, and most importantly, why they worked. The study also examines aspects of the implementation that were problematic, and again seeks to explain why this is so.

1.2 Background to the study

1.2.1 Development and implementation of e-learning

This research examines the implementation of an e-learning tool at Apache Energy, an oil and gas company operating in Western Australia. The study's research questions were formulated to describe and explain the implementation, looking particularly at relationships between the design of the e-learning tool, the way in which it was implemented, and the outcomes that emerged. The research is the result of a personal journey in the area of educational innovation, through sometimes difficult terrain. The path has never been dull, cutting its direction through development, implementation and reflection phases of e-learning in the Australian Vocational Education and Training (VET) sector and industry over a six year period

between 1999 and 2005. Table 1.1 outlines the researcher's role in development and implementation of e-learning projects since 1999.

Table 1.1:
Researcher's Involvement in e-Learning Development and Implementation Projects

Year	Tool	Initiative	Role
1999	The Hospitality Internet Project	Certificate I in Hospitality	Project manager
2000	The Retail Toolbox	Certificate II Retail	Project manager
2001	Flexible Learning Leaders	National professional development initiative	Flexible Learning Leader
2001	CyberTots	Certificate III Children's Services	Project manager
2002	TruVision	Certificate I in Information Technology	Project manager
2003	Hamilton Air	Certificate III in Business Studies	Project manager
2003	Toolbox Initiative	ANTA Toolbox mentor	Mentor
2003	Rosebud Resort	Business English Cambridge	Project manager
2004	Oz Air	Certificate II Business	Project manager
2004	Grange Care Services	Certificate III Aged Care/Home and Community Care	Project manager/ Educational designer
2005	Apache e-learning tool	Safety in the oil and gas industry	Project manager/ Educational designer

As with many journeys, the knowledge gained from travelling is more important than reaching the destination. For example, the development of insights into problem-based learning prompted the researcher to increasingly look for ways to situate learners in meaningful contexts where they would be afforded opportunities to be actively engaged in the learning process, simulating the real world and encouraging the application of learning to work situations. The Grange Care Services tool is an example of how these insights became manifest in the development of a concrete e-learning tool. Grange Care Services is a simulated aged care and home and community care facility where learners are cast in the role of employees who were inducted into the virtual organisation. In this role, learners are introduced to fellow employees and clients and also invited to respond to situations,

for example, by interpreting care plans, progress notes and organisational policies and procedures. To obtain a Certificate III qualification in Aged Care or Home and Community Care, learners are required to demonstrate competency in both the theoretical and practical aspects of the industry. To respond to this requirement, the simulated environment is augmented by workplace projects designed to apply theoretical knowledge to real world contexts. The tool assumes the existence of a teacher, who is expected to configure the design to the needs of the learners. A Teacher's Guide is provided to assist in this task.

The activity-based features of the nine e-learning tools in Table 1.1 have been influenced by the design principles proposed by Oliver (2001). Oliver has made a significant contribution to e-learning in the VET sector in Australia having been the lead mentor in the Australian Flexible Learning (AFL) Framework's Toolbox Initiative, which has been responsible for the creation of over 90 sets of e-learning materials since 1999. Developers of e-learning tools in VET are encouraged to consider a set of design principles that define sound teaching and learning practice. For example, the AFL Framework (2004, p. 1), suggests that Flexible Learning Toolboxes should have the following design features:

- a firm basis in an educational model which recognises an active, constructive role for learners;
- learning activities which engage the learner in active processing of the subject matter rather than mere knowledge acquisition;
- learning settings and tasks that encourage meaningful online communication and interaction (between learners as well as between teachers and learners);
- content resources which are visually attractive, motivating to use and organised logically for ease of navigation;
- representations of authentic and real life settings in preference to textual descriptions.

These features form the basis of constructivist learning theory, which is at the core of the theoretical framework that governs this study. This is described in Chapter 3.

The AFL Framework Toolbox initiative is a well thought out e-learning product development initiative that is informed by sound design principles. However, like many similar initiatives world-wide, there is a void between the development of

e-learning tools and their implementation. While there have been a few successful instances, there is evidence in the literature that take-up of educational models that optimise the effective use of information and communications technologies (ICTs), has been slow and sometimes problematic (Bate, Robertson, & Smart, 2003; BBC, 2005; Carlivati, 2002; Dineen, 2005; Harper, Hedberg, Bennett, & Lockyer, 2000; Harvey, 2005; Houlden & Houlden, 1999; Rood, 2004; Steed, 2001).

Despite the challenges to implementing e-learning, many education and training institutions and enterprises continue to give serious consideration to how the educational application of ICTs can be effectively harnessed to enhance learning and/or improve organisational performance. However, as Pittard (2004) points out, there is a lack of rigorous, evidence-based research into successful practices. A vast and growing number of ICT options for learning are now available, ranging from the simple use of email to high-tech multimedia games and simulations. Research into successful applications of these options is needed to guide and support future implementation practices.

In reflecting upon how e-learning tools are implemented in Australia, it is clear that there are sometimes discrepancies between the intended design, how this design is interpreted by teachers, and how learners interact with what they see as the tool (Bate et al., 2003; Eklund, Kay, & Lynch, 2003). For instance, learners who are operating in a corporate setting (e.g. a workplace) may choose not to engage in collaborative activities that may be embedded in the design, although this may be a key aspect of the designer's approach. This point is made by Bauer (cited by Galagan, 2001, p. 1), a senior manager for e-learning marketing in the Internet Learning Solutions Group at Cisco:

> Reaching competency quickly is what counts now - not the thickness of the book, the length of the class, or the number of people in the seats. On the road to competency, a person may have formal training, do private study, read a white paper, listen to a seminar, or attend an event. The point is, did they come out competent, sooner rather than later?

This notion of rapid competency achievement may not sit comfortably with the ideal of the inquisitive, reflective lifelong learner. However, the realities of learning in workplaces should be acknowledged. For example, Harris and Volet (1996) point

out that trainers, managers and employees should recognise the tension between the worker as a learner and the worker as a productive unit.

This study attempts to explain and clarify these tensions by examining the implementation of an e-learning tool in a corporate context. The implementation of an e-learning approach in a corporate setting is a complex matter that involves management support, relevant content, supportive facilitation, administrative and supervisory strategies, sound equipment, networks and facilities, and learners that are open to using technology. A detailed case study approach is adopted to help to describe and explain these complexities.

1.2.2 The Apache Energy e-learning tool and its implementation

The researcher's journey as an e-learning developer and implementation facilitator culminated in 2005 with completion of the Apache Energy e-learning tool. This tool, which forms the basis of this study, was purpose-built by Elearn.WA under contract to Apache Energy in Western Australia, a multi-national oil and gas company.

In 2004, Apache Energy made a strategic decision to develop and implement e-learning as a way of enhancing site safety at its operations in the North West Shelf of Western Australia. The company had experienced a period of sustained growth that had resulted in significant development and maintenance activity at its facilities in Western Australia. Much of this development and maintenance work was contracted out, with Apache Energy employees undertaking primarily management and supervisory roles. This situation meant that, increasingly, contractors with limited or no experience in the oil and gas industry were asked to work at off-shore production facilities. Oil and gas production facilities handle flammable and potentially lethal substances at high pressures. The chance of something going wrong in these conditions is low, mainly because of well established safety procedures that are in place. However, a critical component of risk management at an oil and gas facility is to ensure that all contractors are aware of:

- the properties and dangers of working with oil and gas at high pressures; and
- the safety procedures that manage routine and non-routine work.

Thus, the primary rationale for the development and implementation of the e-learning tool at Apache Energy was the need to provide a rigorous safety induction for a rapidly growing contracted workforce that was increasingly inexperienced in working in oil and gas environments.

In addition to this safety focus, an efficiency driver became more and more obvious with the growth of the inexperienced contracted workforce. Contractors attending an Apache Energy oil and gas facility typically travel by air from metropolitan Perth, 1,300 kilometres south-east of the North West Shelf, on a "two weeks on/two weeks off" basis. Flights occur early in the morning and include a short helicopter shuttle with contractors generally arriving at a facility at mid-morning. For those new to a facility, a 4 to 6 hour safety induction would then take place. On completion of this induction, contractors would make contact with their identified supervisor, receive a job-specific induction and then obtain directions on work priorities. In most cases, these processes would not be completed until late afternoon and contractors would have been advised to commence productive work on the following day. From a productivity perspective, the day is lost. In an environment of rapid growth, this was a concern for Apache Energy.

Apache Energy sought to develop a learning tool that offered flexibility for a contracted workforce. This flexibility had to allow for self-paced learning such that individuals could complete tasks at a time that was convenient to their personal schedules, and at a pace that was appropriate to them. In this way, learning was primarily conceived as an individual endeavour with little or no social interaction with other contractors or supervisors at the point of engagement with the e-learning tool.

Apache Energy predicted that contractors would have different levels of prior knowledge and motivations for learning and sought to provide a user-centred design where both "self-selection" of activities and resources and a "step-by-step" approach were provided. The company appreciated that its contracted workforce operates in a

time-scarce environment and, via a dedicated e-learning centre in metropolitan Perth Western Australia, undertook to offer opportunities for contractors to gain competency quickly or engage with the resources at a deeper level. When contractors attend the e-learning centre, there is a quick and seamless learning process available so that experienced oil and gas professionals can fast track through the e-learning tool if required.

From the perspective of Apache Energy, therefore, three key outcomes were expected to emanate from the implementation of the e-learning tool:

- A safety induction that was *effective* in enabling contractors to develop their understanding in relation to targeted safety issues in oil and gas.
- A safety induction that was *efficient* in its administrative and support attributes.
- A safety induction that was *flexible* in that it facilitated learning at a time and pace that was appropriate to a contracted workforce.

The e-learning tool has two components. The first component is a broad based introduction to the risks associated with working at an oil and gas facility. The second component focuses on Permit to Work systems that operate in the oil and gas industry. Each component provides opportunities to interact with learning activities, learning resources and an assessment.

The assessment tasks can be completed before, after, or in conjunction with the learning activities and learning resources provided. The navigation is such that learners can access any aspect of the tool in one or two clicks. The components of the e-learning tool are now described.

1.2.2.1 Learning activities

In light of the objective of affording contractors with opportunities to reach competency quickly, learning activities are essentially short exploratory sequences cast as simulations or self-tests that are integrally related to primary safety concerns at Apache Energy. The function of the activities is to encourage learning by doing and attention is given to graphical and written feedback so that safety concepts are

understood and reinforced. For example, the fire simulator encourages learners to explore the consequences of various ignition sources (e.g. cigarette, camera) in an environment where natural gas could be present, in both safe and unsafe conditions.

1.2.2.2 Learning resources

Audio visual presentations (e.g. offered as short authentic documents or reports and simulated newspaper articles) constitute the learning resources in the program in that they provide background and introductory content for each segment of the tool. Also contained in these introductory segments are safety hints, glossary items and real world examples. An example of a typical 'real world' example used as a case study in the e-learning tool is a multimedia presentation of the North Sea's Piper Alpha disaster in 1988 that resulted in the loss of 165 lives. A "history" on the disaster is provided, and participants are invited to consider the events leading up to an explosion and consequent fire that ran out of control. The important learning outcome from the perspective of the e-learning tool is to make distinctions between Piper Alpha's degraded Permit to Work system and the Permit to Work System operating at Apache Energy.

1.2.2.3 Assessment

Two assessments are presented to learners. The first assessment is targeted at basic safety understandings in oil and gas environments (e.g. properties of oil and gas, flammability, working in confined spaces). The second assessment is aimed at gauging the extent to which information about the Apache Energy Permit to Work system has been understood by contractors. Both assessments attempt to use a variety of approaches to provide reliable results information that is then considered and verified by on-site safety advisers. Specifically, each assessment comprises of a set of questions that use multimedia formats to simulate, as far as is practicable, oil and gas safety scenarios at Apache Energy. Both assessments are required to be completed before learners attend site.

Six workstations are provided at a dedicated e-learning centre (referred to as the Apache Energy e-learning Centre). These are linked to the e-learning tool and a results data-base via a local area network (see Figure 1.1). As contractors engage

with the two assessment items embedded in the tool, results are collected, stored in a database, and through Active Server Pages (ASP) code are automatically compiled into a spreadsheet and emailed to the appropriate oil and gas facility in the North West Shelf (Varanus Island or the Stag platform). Administrative and technical support is provided at the e-learning centre to ensure that contractors are guided through the learning process. Each day when contractors arrive on site, the results from their e-learning experience are considered by on-site safety advisers.

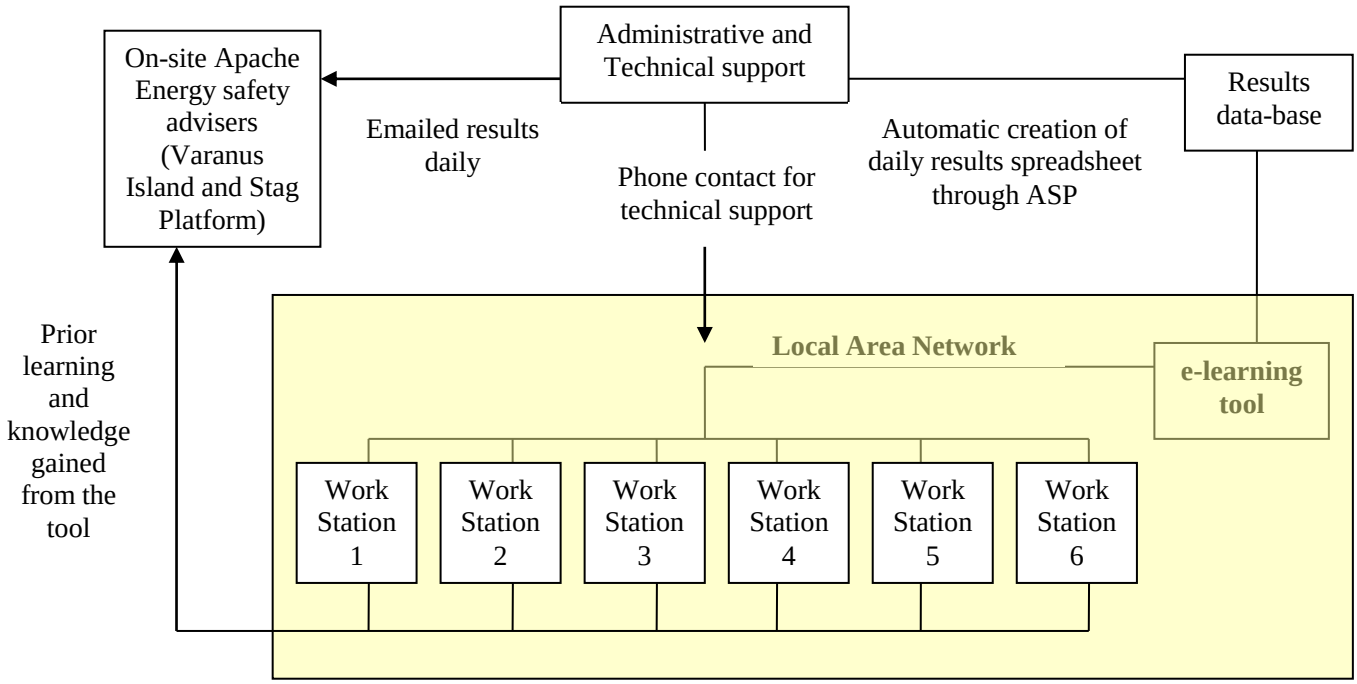


Figure 1.1. **Diagram representing the model of implementation for the Apache Energy e-learning tool.**

It is the responsibility of safety advisers at Apache Energy to maintain safety standards articulated in the organisation's Safety Plan, and ensure that all personnel on a production facility are aware of the risks associated with working in an oil and gas environment. Safety advisers at Apache Energy use the e-learning tool in a diagnostic fashion. When contractors arrive at the facility, the results of the two assessment items have already been analysed by the on duty safety adviser. The safety adviser looks at areas where there is a perceived knowledge gap and if necessary, works through issues on a one-to-one basis. If participants passed the assessment items at the e-learning centre, the safety adviser confirms that contractors are equipped with basic safety understandings through targeted

questioning, and if necessary re-engagement with one or more assessment items for verification.

1.2.2.4 Facilities

Six work stations are provided at the Apache Energy e-learning Centre (see photograph as Figure 1.2) giving access to the e-learning tool. There is a significant amount of audio-visual material in the tool and headsets are worn by contractors as they work through the various activities, resources and assessment items. Administrative and technical support is provided.

Figure 1.2. **Photograph of the Apache Energy e-learning Centre in metropolitan Perth, Western Australia.**

Contractors generally engage with the e-learning tool in a self-paced manner over a 4 to 6 hour period. This includes completion of the two assessments.

1.3 Purpose of the study

This research tracks the initial implementation of the e-learning tool at Apache Energy between May and December 2005. It describes how the tool was implemented and gauges the extent to which the implementation of the tool was effective for both Apache Energy staff and the contractors that engaged with it. In essence, it seeks to understand a specific e-learning initiative. If it worked, what aspects worked best and why they worked.

The following research questions will guide the study. These are discussed in detail in Chapter 4, Methodology.

1. What design principles underpin an e-learning tool developed for an oil and gas organisation in the area of workplace safety?

2. How has this e-learning tool been implemented in an oil and gas organisation?

3. To what extent does the implementation of the e-learning tool achieve desired outcomes?

The primary objective of the research is to develop a better understanding of how e-learning is used in a corporate, adult learning environment; more specifically:

- knowledge generation about the factors that affect e-learning in a corporate, adult learning environment;
- a better understanding of the type of learning to emerge as a result of engaging with e-learning; and
- consideration of the issues, enablers, barriers and challenges surrounding e-learning in a corporate, adult learning environment.

The approach to the development and implementation of the e-learning tool at Apache Energy contrasts with more typical approaches adopted in the oil and gas industry where "off-the-shelf" e-learning products are purchased and then implemented. Comprehensive planning underpinned the design, development and implementation phases of the Apache Energy e-learning tool to ensure that it met organisational and contractor requirements. This level of planning and explicit management support, together with the steady stream of contractors that engaged with the tool (256 between May and December 2005) suggests that the implementation of e-learning at Apache Energy provides a rich and potentially illuminating case study that may inform other e-learning contexts.

1.4 Significance of the study

Harper et al. (2000) propose that there is no universally accepted wisdom on the best method for the implementation of new learning technologies, either in Australia or internationally. The authors argue that, while better design models are needed to support development teams in responding to the opportunities that new learning technologies present, there is a lack of published reporting in vocational settings on the design, development and evaluation of learning environments that integrate e-learning. There is a vacuum of knowledge at the very time that knowledge is most

needed. Ironically, at a time where knowledge about e-learning is embryonic, there is an ever increasing appetite to push the boundaries of new learning technologies. Moyer (2002, Background, para.4) argues that the absence of credible research and careful decision-making inevitably leads to undesirable outcomes in the rush to "go digital":

> The growing number of accounts of high drop-out rates (failure to complete), lack of user satisfaction and no differences in performance suggest that digital learning might not be the panacea often implied by proponents of digital learning products and services. While we cannot yet establish all reasons for the complaints, there are obvious contributing consequences of a rush to "go-digital": (a) poor quality content regardless of format, (b) poor instructional design, (c) technology and infrastructure problems, (d) inappropriate software decisions, and (e) inappropriate content for the business and learning objectives.

The negative consequences of going digital, as described above, were anticipated by Apache Energy. The choice of content for the tool was driven by the safety team at Apache Energy who saw it as relevant for the objective of providing a generic introduction to site safety and operating under a permit system. The tool was designed according to principles that define effective learning. These principles, outlined in Table 1.2, are attributed to Oliver (2001), and are considered more fully in Chapter 4, Methodology.

Table 1.2:
Characteristics of Apache Energy's e-Learning Design

Setting	**Program**	**Design features (Oliver, 2001)**			**Assessment**
		Activity-based	**Real world context**	**Collaborative learning**	
Private sector company – Apache Energy	In-house oil and gas safety induction program – (non-accredited)	Activities are provided as self-tests with immediate feedback	Oil and gas company – real life scenarios and policies/ procedures are used	Safety adviser provides support on-site	e-Learning tool is formative with workplace verification

The technology and infrastructure underpinning the implementation of the e-learning tool was sub-contracted to a third party training company with a proven track record in the provision of safety training in the resources sector. One area that

was not specifically planned for was the extent of human intervention (facilitation) of the e-learning tool. This was to have consequences, and these will be discussed in Chapter 8, Discussion and Conclusion. The pertinent point, however, is that some important conditions for the successful application of a learning innovation were in place at Apache Energy at the commencement of the implementation. From the perspective of Apache Energy the content of the e-learning tool is appropriate for the needs of its clients, the e-learning tool is well designed, and the implementation of the e-learning tool is professionally supported.

Further, Apache Energy welcomed this research as a way of monitoring the effectiveness of the e-learning tool and identifying areas for improvement. This is uncommon in a competitive industry environment.

The literature review undertaken to form Chapter 2 of this thesis clearly shows a paucity of rigorous, evidence-based research into corporate e-learning. The result is a potentially skewed view of why education and training is conducted in workplaces. It is important to consider that the drivers for e-learning in corporate settings are sometimes different from those that are evident in public sector education and training. For example in higher education, e-learning designs are most likely to be concerned with developing and maintaining environments that encourage deep learning. In workplaces, the use of e-learning may be more about return on investment (ROI) and the ability to respond to the need for targeted just-in time learning. In these circumstances, time to reflect upon and discuss concepts is scarce. Knowledge is integrally related to the task at hand, and the achievement of immediate results is paramount.

In a study of the effectiveness of a work-based training model for welding apprentices at six industrial sites, Brooker and Butler (1997) concluded that there was a clash between the learning goal and the production ethic, and that this sometimes reduced opportunities for effective learning. Newton and Hase (2002) discerned a similar conflict between managers and trainers in the mining industry in Queensland. This research understands that there are different and competing priorities facing managers and learners in corporate settings and views corporate e-learning in the context in which it is set.

1.5 Organisation of the study

This thesis is comprised of eight chapters. This chapter has presented a background for the study and outlined its purpose and significance. In Chapter 2, a review of the current literature on e-learning is provided, particularly as this relates to corporate contexts. Chapter 3 describes the theoretical framework in which the study is situated, and to which its findings relate. Chapter 4 provides an overview of the research methodology. An interpretive case-study framework is used for the study involving the collection of data from a variety of sources which are primarily qualitative. Chapters 5-7 present the data and identify some key themes that have emerged from the study. Finally, Chapter 8 provides an interpretation of the data, discusses key findings, and introduces possible avenues for further research.

Chapter 2 will review the literature on corporate e-learning.

CHAPTER 2
Literature Review

2.1 Chapter overview

This chapter presents an overview of the current literature on corporate e-learning. It focuses on three distinct types of research that have emerged:

- Reports and commentaries from organisations and individuals that represent the corporate e-learning sector (e.g. the American Society for Training and Development, the Masie Center, the Australian Society for Training and Development).
- Commissioned research into industry e-learning models and requirements (e.g. the Australian Flexible Learning Framework, the National Centre for Vocational Education Research).
- Education professionals and academics critically appraising corporate e-learning and seeking to make a contribution to this area of inquiry.

The review highlights that, although there is a good deal of commentary and opinion on the subject of corporate e-learning (particularly on the World Wide Web), there is a paucity of evidence-based research that can be used to inform objective decision-making on when, and how, to use technology to support learning in organisations. The thesis argues that this is a necessary condition for optimising the benefits of e-learning for all stakeholders, and presents a case study that may be particularly pertinent for those seeking to use e-learning to introduce employees and contractors to safety issues.

2.2 Background

In reviewing the literature on the subject of e-learning, it is evident that a variety of terms are used to discuss similar phenomena. Educational technology, technology enhanced learning, new learning technologies, interactive multimedia, electronic learning, online learning, web-based learning, online delivery and e-learning are all commonly used.

The term online learning emerged in the latter half of the 1990s in response to a widespread perception that the Internet could deliver both electronic content, but also facilitate an environment where electronic communication and exploration could flourish. Many organisations, particularly large corporations (e.g. QANTAS, Telstra, Ericsson), invest in infrastructure that combines the features of just-in-time electronic content and support mechanisms such as electronic bulletin boards.

The notion of online learning as something that runs alongside, but does not intersect with face-to-face learning, has been somewhat overtaken by the broader term e-learning, which absorbs both Internet and non-Internet based content delivery and communication methods into a model that can be integrated into a variety of circumstances. For instance, an e-learning experience may use the Internet for email and file storage, the World Wide Web for web searching, online discussion, chat and podcasting, and augment these social tools with interactive content and video footage delivered via CD, face-to-face discussions and traditional presentations, in addition to using text books and other publications. In short, good practice in e-learning is increasingly being characterised by a blended approach that uses a variety of media and learning strategies based upon a knowledge of the needs and capabilities of the learner (Debande, 2004; Smart, 2002; Thiagi, 2000; Zenger & Uehlein, 2001).

Much has been published on the subject of how ICTs can support learning. Entire refereed journals are now devoted to the subject (e.g. the International Journal on e-Learning, the Electronic Journal of eLearning, the Journal of Educational Multimedia and Hypermedia etc). The term ‘e-learning’ encapsulates a broad range of ICT-facilitated learning approaches that have been applied across both the public and private sectors. For the purposes of this literature review, e-learning will be used

to describe a "continuum of synchronous and asynchronous processes, which include computer-mediated learning, distributed learning networks, web-based learning, teaching aided learning, on-line learning and asynchronous learning networks" (O'Fathaigh, 2002, p. 1). Viewed in this way, e-learning environments and tools constitute a broad spectrum of computer-mediated learning that ranges from real time and place interactions, to delayed interactions that can occur any time and in any place.

Close scrutiny of published research on the topic of corporate e-learning reveals that most contributions fall into one of three categories:

- Commentators/consultants representing the corporate e-learning sector, primarily concerned with issues of how to effectively manage knowledge in large organisations, and provide efficient, just-in-time, in-context learning to employees. Examples of commentators from this category include the American Society for Training and Development (e.g. ASTD, 2005; ASTD & NGA, 2001) and its associated e-learning website Learning Circuits (e.g. Ellis, 2004), the Australian Society for Training and Development (e.g. Dallow, 2005), The Masie Center (The Masie Center, 2003), Rosenberg (2001; 2005) and Galagan (2001).

- Commissioned research, evaluation and policy documents from the public education and training sectors seeking to confirm policy decisions and articulate future strategic directions, particularly in relation to forging relationships with industry (Australian Flexible Learning Framework, 2005; Brennan, 2003; Brennan, McFadden, & Law, 2001; Cashion & Palmieri, 2002; Eklund, Kay, & Lynch, 2003; Harper, Hedberg, Bennett, & Lockyer, 2000; Schofield, 2003).

- Education professionals and academics critically appraising e-learning in VET and workplace contexts, and striving to harness educational technologies to optimise student learning. Some authors that could be included in this category include Bennett and Reilly (1998), Kim, Bonk and Zeng (2005), L. Davies (2002), Oliver (2001), Ring and Reeves (2002), Smith (2000), and Smith, Wakefield and Roberston (2002).

In some respects, these categories are artificial and some authors/commentators contribute to more than one category. However, for the purposes of providing a coherent literature review that relates to this study, a summary of the three categories is now provided. The implications of the literature review for this study is then discussed, along with a consolidated summary at the end of the chapter.

2.2.1 Reports and commentaries from organisations and individuals that represent the corporate e-learning sector

The corporate sector potentially has a lot to gain from e-learning technologies. In this sector knowledge and the rate in which knowledge can be shared in an organisation is sometimes the difference between success and failure. As CEO of IBM in 2001 Laurence Prusak (cited in Rosenberg, 2001, p. 9) states: "The only thing that gives an organization a competitive edge…is what it knows, how it uses what it knows, and how fast it can know something new".

Some large geographically dispersed corporates like Cisco, AT&T, Dell Computers, Merrill Lynch, Telstra and QANTAS have invested in technology to promote organisational learning. These organisations see the linkages between e-learning and knowledge management, and Rosenberg (2001) cites some of them as examples of good practice. He suggests that smart organisations blend online training and knowledge management, empowering individuals with the skills and tools to reach their potential, and the organisation to improve its productivity and competitive edge.

However, despite this optimistic view of the application of technology to organisational learning and knowledge management, there is a sense that corporate e-learning is in a state of dysfunction. Some argue (e.g. L. Davies, 2002) that this is because pedagogical concerns are subservient to efficiency drivers in the corporate sector. These sentiments are highlighted by Allen (Ellis, 2004, para.18). In an interview published on Learning Circuits, Allen proclaimed that corporate e-learning is boring for reasons mainly associated with the application of traditional instruction techniques to the electronic medium:

> E-learning is often boring for the same reasons much traditional instruction is boring. It focuses on content presentation rather than the learning experience. In fact, I find that 99 percent of it all follows the 'tell-and-test' paradigm: convey a block of content through lecture, books, screens, movies, bullet slides, and so forth. Then, give a quiz.

The sacrifice of pedagogical concerns in favour of technical interests and perceived economies of scale (Davies, 2002) is not surprising. In most corporate contexts, learning is not "core business", but a means towards an end. In an evaluation of corporate e-learning in a large telecommunications company, Ring and Reeves (2002) discerned that the critical business objectives were to save training costs and reduce training time. The focus on these issues is symptomatic of a desire to achieve tangible, measurable (and mostly short term) benefits rather than less quantifiable outcomes such as confidence in using computers and increased job satisfaction. Many organizations "contract out" the function of developing and/or supporting training, and this has led to an environment where vendors and software development companies have thrived, sometimes to the detriment of quality learning and development.

Notwithstanding these difficulties, partnerships between industry and education and training providers are beginning to emerge. For example, in an interview in the Knowledge Tree e-Journal, Coyne (2002) discusses the advantages of Crown Casino in Melbourne entering into a partnership arrangement with William Anglis TAFE to solve a compliance problem, and assist new and existing employees in understanding the ethical issues associated with responsible gaming and serving of alcohol.

The Masie Center describes itself as a learning and technology e-Lab and Think Tank for corporate learning. The Center conducts research into what it sees as useful for training and development of professionals operating in the corporate sector. For example, in conjunction with the American Society for Training and Development (ASTD), the Masie Center conducted a study into e-learning acceptance levels in 16 companies that comprised over 700 learners (ASTD & The Masie Center, 2001). The study, entitled "E-learning: If we build it, will they come" concluded that

efficiency drivers, although an important consideration in corporate e-learning, were only part of the picture. Participants in the study reported that their motivations and the motivations of their employers, what the researchers described as the context for learning, were equally important factors.

The Australian Institute for Training and Development (AITD) is also active in promoting e-learning technologies to the corporate sector. In 2004, at the annual AITD National Conference, a key message (e.g. Dallow, 2005, para.1) was that:

> Learning technologies are being better applied and more integrated – the hype of earlier years is subsiding – but learning professionals may need to reclaim some of the direction of learning technologies from the information technology practitioners.

Such sentiments would indicate that the corporate sector is becoming more astute in applying ICTs to learning situations. Indeed there have been some significant reported e-learning and knowledge management success stories in the corporate sector. For example, iVelocity, Telstra's intranet-based knowledge management application, created $10 million cost savings in its first two years of operation to 2001 through effectively managing and sharing knowledge (Ossipoff, 2001).

In a study of four Fortune 500 companies (one in the oil and gas industry), Waight and Stewart (2005) found that all companies valued and supported the adult learner in designing e-learning courses. Further, the authors claimed that these companies largely complied with a conceptual model for e-learning that emphasises company leadership, sound infrastructure and financial support for e-learning, thorough needs assessment, cognisance of contemporary learning theory, creativity in instructional design and decision-making within the context of ROI. One of the weaknesses of the study is that it drew its data solely from "e-learning representatives" within each company, rather than a cross-section of e-learning consumers. However, the examples show a significant commitment to e-learning within some large companies, and what on face value appears to be the beginning of a robust conceptual model for the implementation of e-learning in corporate settings.

QANTAS College Online, launched in 1997, was one of Australia's first web-based training systems. Since its inception, it focused on "just-in-time" learning, and now serves over 30,000 QANTAS staff worldwide. QANTAS College Online, which won a national training award for excellence in 2001, primarily focuses on 'soft skills' rather than the IT or technical skills courses usually available online. According to Mildon (2000, Abstract, para. 3), the Manager of Corporate Learning (until 2002):

> In 1997 approximately 75% of Qantas staff did not have regular access to a PC in the workplace. The introduction of Qantas College Online had significant implications for learners, managers, trainers (both internal and external) as well as Qantas College staff. Today Qantas College Online has 5,000 registered users, who access over 60 corporate and technical skills courses.

Cisco Internet Learning Solutions group claims to be having huge successes on both efficiency and effectiveness indicators as a result of implementing a comprehensive competency-based e-learning system. Galagan (2001) reports that in the manufacturing section alone, savings of $1 million per quarter are derived from e-learning implementation. No description of implementation practices was given, and data were not provided on the quality of learning that the approach generated. However, the use of the system, which is characterised by the development of small chunks of knowledge that can be understood by employees in context, adding value to their work performance, suggests some level of learning is taking place.

Tom Kelly, the Manager of the Internet Learning Solutions Group at Cisco, suggests a prescriptive "top-down" approach to e-learning. He believes that the learner only wants the skill and knowledge to do a better job or answer the next question from a customer. The Cisco e-learning mantra is one in which trainers are often not seen as best equipped to develop engaging e-learning content. Kelly believes that "Putting trainers in charge of e-learning is like putting postal workers in charge of email" (quoted by Galagan, 2001, p. 1).

It should be acknowledged that what constitutes success in the corporate sector (ROI) may not necessarily have much to do with learning as educators understand the term. According to Waight and Stewart (2005, p. 403), the driving force behind the decision by Halliburton (a multi-national energy services group) to opt for

e-learning was "to reduce costs and increase access". Considerations for enhancing or deepening learning opportunities were not noted by the authors.

There is little evidence in the literature that small to medium enterprises, which comprises most of Australian industry, have shown the same appetite for e-learning as the larger corporate players.

Commentators on corporate e-learning tend to take extreme positions on the subject of e-learning focusing on either "success stories" (typically measured in terms of cost savings) or generic problems (e.g. poor educational design, lack of social interaction). There are very few serious studies in the literature that provide insights into how e-learning has contributed to knowledge construction and increased job satisfaction amongst employees and delivered lasting culture change for employers.

There are a growing number of commentators, bloggers and websites that generate and share knowledge about e-learning in the corporate sector. Many contributions bring practical insights and a wealth of knowledge and experience to the debate on the effective use of ICTs for learning. However, the material usually does not attend to matters of research method with any rigor and is seldom refereed. Schofield (2003, p. 163) also points out that "Even where the information they provide is objective, reliable and credible, perceptions of conflict of interest remain". Contributions from the corporate sector should be viewed on their merit, but treated with caution.

2.2.2 Commissioned research into industry e-learning models and requirements

The e-learning experience of industry and VET does not feature strongly in the literature. Pittard (2004) in her examination of policy development in e-learning in further education in the United Kingdom (equivalent to VET in Australia), argues that the greatest potential of e-learning lies in the further education sector probably because of its close links with industry. However, like Harper et al. (2000), Pittard acknowledges that the research tradition in further education is not strong, and that there is very little research that provides solid, defensible examples of e-learning implementation. According to Pittard, the most crucial question underpinning the

development of new knowledge in the ICT research field is ‘what works’ in e-learning. The enormous variation and ever-changing settings in which e-learning solutions are applied, suggests that identifying ‘what works’ will be a challenging quest for future research.

In the Australian industry context, e-learning policy has been richly informed by commissioned reports and advice from higher education experience. For example, Eklund et al. (2003) provide an excellent summary of the current state of e-learning in VET and industry in Australia. The summary is grounded in a sound knowledge of educational theory, and offers a depth of practical experience in evaluating and testing e-learning in competency-based environments. However, the paper is primarily focused on VET, and does not examine the dynamics of e-learning environments that operate within a corporate context.

The VET sector serves a diverse set of client groups including vocational education in schools, technical training, apprenticeship training, para-professional education and training, adult and community education, migrant education, corporate training and labour market programs. One of the challenges currently facing this sector is to discern appropriate ICT learning solutions for each of these client groups be they single subscriber or corporate. The approach of the AFL Framework has been to create the tools (e.g. Flexible Learning Toolboxes) around which e-learning can be successfully implemented. Oliver (2001) has helped e-learning development teams understand the importance of building e-learning tools that encourage learners to actively construct meaning from engaging with the e-learning environment. As at June 2006, 90 Flexible Learning Toolboxes have been developed under the AFL Framework, most of which are grounded in solid and consistently improving educational design principles (Oliver & Blanksby, 2003). The authenticity of the learning experience has been a critical design specification, and many Flexible Learning Toolboxes use metaphors to situate learners in industry settings. Providing the learner with activities and problems, supported by resources and provision for teacher/peer interaction has been central to the design. A key aspect of the approach to e-learning product development in the VET sector has been on designing for customisation, and this has led the sector to consider options for digital storage and

retrieval (Wirski, Oliver, Hingston, Omari, & Brownfield, 2002) which enhance the overall flexibility of the tools.

Through its various initiatives, the AFL Framework set content development within a broader framework that includes work-based professional development, flexible learning leadership, research and communities of practice. It has also sponsored the Virtual Learning Community and the Knowledge Tree e-Journal of Learning Innovation as ways of promoting debate about e-learning implementation practices.

The AFL Framework has conducted a number of targeted evaluations into Flexible Learning Toolboxes to inform decision-making on future development. Two evaluations of Toolbox usage in the Australian VET sector by Eklund and Kay (2002; 2003) point out a number of examples of meritorious e-learning implementation. The 2003 evaluation provided 69 Registered Training Organisations with the opportunity to implement one of 14 Flexible Learning Toolboxes. Forty-nine organisations chose to review a Toolbox, and 29 went on to use it with learners. Those that used a Toolbox provided favourable feedback on all aspects of design, content and technology, and were positive about being able to incorporate it into teaching practices. Most were using it as part of a blended approach. This was also noted by Brennan (2003) in a commissioned report for the National Centre for Vocational Education Research (NCVER).

Over the past five years, NCVER has commissioned 19 research publications on the use of new learning technologies in the VET sector. These publications generally take the form of research on issues relating to pedagogy, particularly in TAFE (e.g. Brennan, 2003; Cashion & Palmieri, 2002) and the take-up and effectiveness of online learning (Brennan, McFadden, & Law, 2001; Hill et al., 2003; Peters & Lloyd, 2003). Most conclude that there is an increasing appetite for e-learning in VET and industry, but those implementing e-learning have much to learn about effective educational design and tailoring e-learning to meet the needs of a diverse set of clients.

Schofield's (2003) study of e-learning in four large corporations, (ANZ, FordStar, QANTAS and Theiss) provides valuable insights into the factors that propel large

dispersed organisations to consider e-learning solutions. She argues that where e-learning is part of an explicit corporate strategy, it is generally seen by stakeholders as having value. Where it is disconnected from corporate strategy, then it is perceived as a cost. Schofield acknowledges that business units are required to interpret corporate strategy, and that this creates a whole new operating environment for human resources professionals. She also alludes to an impending scenario where corporate e-learning will extend to contractors and suppliers, a situation that has already emerged at Apache Energy.

The AFL Framework has recently attempted to engage business in more sophisticated models of e-learning through its Practical Guide to e-Learning for Industry (2005) and associated web discussion forum. The Framework also supported the development of ten case study business e-learning exemplars as a way of providing direction and leadership to industry. It is too early to gauge the extent to which these initiatives have impacted on the corporate sector. However, the identification of industry as a specific project under the AFL Framework suggests that the corporate sector is seen as a potential market for VET and the boundaries between public sector and corporate learning are perhaps beginning to blur.

Over the past five years, the AFL Framework and the NCVER have commissioned valuable research that richly informs providers of training. It may be too early to gauge the extent to which this has been useful to the corporate sector, where alignment with business strategy is primarily driving e-learning decisions (Schofield, 2003). However, the literature review confirms that there is a chasm in perceptions and attitudes between the VET and corporate sectors on what e-learning is, and how it can be most effectively harnessed.

2.2.3 Critical appraisals of corporate e-learning

Much of the literature on e-learning is concerned with the development of sound theoretical frameworks in which the design and implementation of technology-supported learning can take place.

There is now evidence of some agreement in the literature on the important features of effective e-learning design (Eklund, Kay, & Lynch, 2003; Herrington, Oliver, & Reeves, 2003; Jonassen, Peck, & Wilson, 1999; Oliver, 2001; Reeves, 1999a). For example, Oliver (2001) articulates a model of e-learning design that acknowledges the roles of learning activities, learning resources and learning supports in e-learning design. The distinction between e-learning activities and resources is particularly important because it suggests that e-learning does not necessarily have to be a passive experience even where learning outcomes are integrally related to information acquisition. Rather, it can be an active, learner-centred, problem-based and task-orientated. In short, e-learning can be about construction of knowledge where learning is exploration and discovery.

Garrison and Anderson (2003, p. 30) propose a framework for e-learning based upon a community of inquiry model. This is shown in Table 2.1.

Table 2.1:
Garrison and Anderson's (2003) Community of Inquiry Categories and Indicators

Elements	Categories	Indicators (examples only)
Cognitive presence	Triggering event	Sense of puzzlement
	Exploration	Information exchange
	Integration	Connecting ideas
	Resolution	Apply new ideas
Social presence	Affective	Expressing emotions
	Open communication	Risk-free expression
	Group cohesion	Encouraging collaboration
Teaching presence	Design and organisation	Setting curriculum and methods
	Facilitating discourse	Sharing personal meaning
	Direct instruction	Focusing discussion

Garrison and Anderson (2003) argue that the community of inquiry model promotes a learner-centred environment where meanings are communally negotiated, misconceptions are resolved and accepted beliefs are challenged. All of these are fundamental to deep learning (Ramsden, 1988). The interplay between cognitive, social and teaching presence provides an attractive model for e-learning in an

educational environment. However, there may be some tensions between the concept of a community of inquiry and the realities of competency-based learning in workplaces. This will be further explored in 2.2.4 – Implications for this study.

Whilst useful models for e-learning design and implementation are beginning to emerge in the literature, rigorous appraisal of the effectiveness of e-learning in corporate contexts, particularly in terms of the learning that has taken place, is almost absent. Those few that have emerged provide valuable descriptions of e-learning implementations, but mostly stop short of examining the range of planned and unplanned learning outcomes that flow from engaging with e-learning.

An exception to this was a study by Ring and Reeves (2002), who provide an example of an independent evaluation of a corporate e-learning initiative. The study outlines both tangible and intangible outcomes. Explicit outcomes of the initiative – to reduce training costs and training time – were augmented by other outcomes that were not planned for, but nevertheless were noted. Technology transfer and expertise amongst staff, development of e-coaching skills, expertise in deploying e-learning for future initiatives, improvements in quality of service and job satisfaction all contribute to a more productive organisation. The authors noted, however, that the costs associated with measuring and "unpacking" these outcomes are considerable, and that the corporate sector is more likely to support evaluations that measure tangible outcomes like the reduction of training time and/or the optimisation of training dollars. The authors refer to these types of studies as impact evaluations. Case studies that dig deeper, considering both tangible and intangible outcomes have the potential to fill a vacuum of knowledge in the field of corporate e-learning. However, such studies typically rely on employers and employees being generous with their time over extended periods. In the case of this research where participants were contractors operating under time scarce and competitive conditions, such a level of commitment was not possible, although some findings on unplanned learning emerged.

Bennett and Reilly (1998) worked with Queensland Alumina Ltd to design, develop and implement a multimedia training package for alumina production workers. The

multimedia tool was jointly designed by Queensland Alumina Ltd and the Central Queensland University to a high educational standard (it was recognised in the 1997 Queensland IT & T Awards for Excellence). The aim of the package was to encourage a better understanding of the Fluid Bed Calciner facility, and according to the authors, employees at the facility showed a high degree of enthusiasm and acceptance of the package. However, the study was embryonic and it was unclear if and how the multimedia tool was supported by trainers or supervisors, whether it was implemented in individualistic or group contexts and how learning was assessed and/or rewarded.

A more recent exploratory study by Newton and Hase (2002) involved interviewing a range of stakeholders in the mining industry in Queensland (employers, employees and industry training representatives) with a view to identifying issues that would affect the implementation of e-learning in the industry. It was noted that e-learning in the mining industry largely equated with independent CD ROM-based learning and introducing the industry to other e-learning opportunities (dissemination of accurate information on what is available) was a priority. Other barriers identified included organisational cultures not valuing learning (and allocating time to train), corporate inflexibility in being able to respond to the opportunities that e-learning presents, and employees themselves not being ready for flexible, independent modes of learning.

Smith (2001) confirms this observation warning against making inappropriate assumptions about vocational learners' preferences and capabilities in relation to self-directed learning. In a study of apprentice preferences for learning, he concludes that there is an overwhelming orientation towards strong direction and social support amongst this cohort either from trainers or peers. Smith concludes that VET learners in workplaces (e.g. apprentices and trainees) and those that have entered the VET system directly from the schools sector are ill equipped to simply engage in flexible learning.

Kim et al. (2005), in a web-based survey of 239 individuals that were perceived to be knowledgeable in the e-learning area, found that workplace learning preferences were moving towards a mix of face-to-face and online instruction (an example of

blended learning). The advantages of blended learning in being able to facilitate stronger direction, scaffolding and/or and social support are not in dispute. Whether corporate training budgets reflect the commitment that goes with blended learning is another question. It is interesting that the individuals that took part in the survey saw the most important issue in e-learning in the next few years as being improving what they described as boring, low-quality content, rather than exploring innovative learner support mechanisms (e.g. e-coaching, online mentoring, online team building) to get the most out of blended learning and optimise knowledge construction for the learner.

This point is also made by Davies (2002, p. 71) who suggests that animate interaction, rather than inanimate interactivity, is the path to more effective learning outcomes for the corporate sector. Davies calls for training professionals in the corporate sector to:

> … be aware of the importance of interaction to learning and be prepared to challenge vendors to justify programs that focus on content and assessment in a linear and iterative way and attempt to minimise human interactions in the eLearning experience.

Davies (2002) suggests that, in the recent past, both the design and implementation of corporate e-learning have been generally unsatisfactory particularly for employees. Despite claims that blended learning models are beginning to turn this situation around, the literature confirms that there is an impasse between learning and productivity objectives. These themes will now be discussed in more detail with specific reference to this study.

2.2.4 Implications for this study

In an attempt to crystalise the depth and breadth of the preceding literature review into manageable and digestible themes that serve to inform this study, there are three issues that are particularly pertinent to the implementation of the e-learning tool at Apache Energy. These are:

- The tension between values of learning and productivity.
- The appropriateness of self-directed models of learning to a contracted workforce.
- The application of contemporary conceptions of good practice adult learning principles to a corporate e-learning context.

2.2.4.1 Tension between values of learning and productivity

In corporate learning, disparate and sometimes antagonistic learning objectives and/or activities sometimes co-exist and remain unresolved. The result can be authoritarian "top down" approaches to corporate learning where employees find it difficult to engage with both the content or delivery strategy. Brooker and Butler (1997, p. 487) see this conflict as a struggle between production and learning: "Where production is valued over learning, a number of effective learning processes are underdeveloped and undervalued".

Where the focus on productivity is not in alignment with what employees perceive as their workplace education and training needs, there is an impasse. This impasse is probably at the root of what Davies (2002) describes as a corporate learning crisis. It is almost inevitable that employee learning experiences will be less than satisfactory when they are set within a framework in which ROI is defined in terms of saving training costs, reducing training time or complying with legislation. There is no easy solution to this dilemma, and it is not within the scope of this thesis to put forward ideas on how e-learning can be best implemented in such complex settings.

A number of authors have presented blended learning as both the future and the salvation of corporate e-learning (Dallow, 2005; Kim, Bonk, & Zeng, 2005; Zenger & Uehlein, 2001). However, for blended learning to be effective in corporate contexts, it needs to add value, for instance in supporting e-learning content with face-to-face and/or online social communicative options. At this stage, beyond rhetoric, there is little in the literature to suggest that such models are emerging. Ainsworth (2000) suggests that there is an "unbearable cost" associated with social interaction. Apache Energy carefully considered the issues associated with providing

a blended learning environment, ultimately deciding upon a model whereby administrative and computing support were provided, but content-specific human support was not.

2.2.4.2 Appropriateness of self-directed models of learning to a contracted workforce

It is pertinent to consider the extent to which corporate e-learners in general, and Apache Energy contractors in particular, are ready for e-learning or other forms of flexible workplace learning. As discussed, it is important not to make inappropriate assumptions about the self-directedness of learners (e.g. Smith, Wakefield, & Robertson, 2002). Figure 2.1 is an adaption of a matrix developed by Smith (2001, p 612) that examined VET learner preferences for directed and self-directed learning.

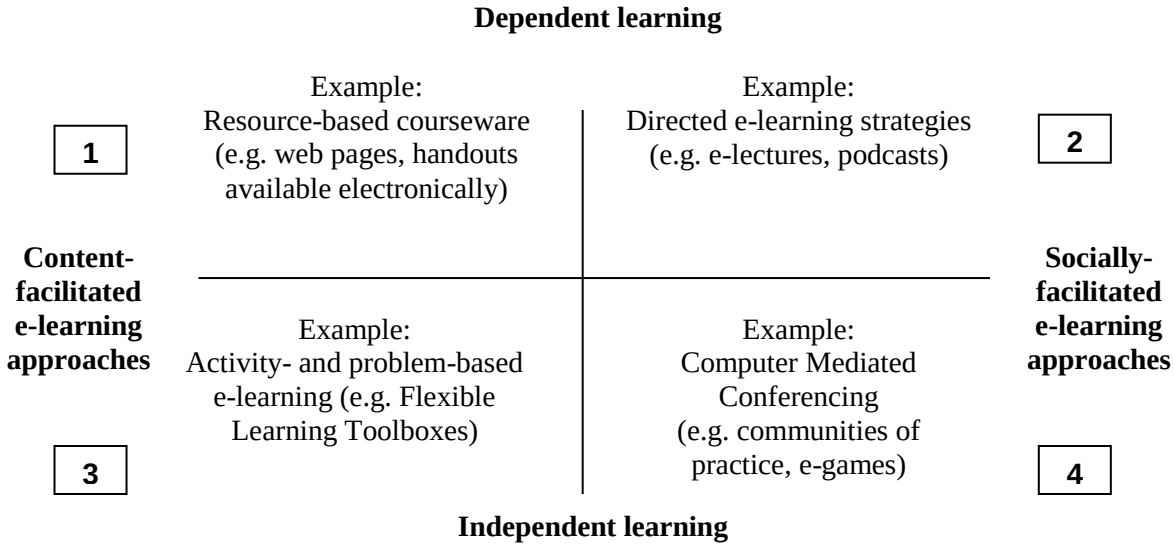


Figure 2.1. **Approaches to e-learning that encourage dependent or independent learning.**

The diagram illustrates the options that are available to the corporate e-learning sector with particular reference to e-learning. Many corporate e-learning designs are firmly situated in quadrant 1, and it is easy to understand why. These are the designs that focus on information provision and the storage and retrieval of facts. Short multiple choice quizzes typically augment designs in quadrant 1 to satisfy those involved that users have retained some or all of the information that has been presented.

Another form of dependent learning (quadrant 2), sometimes used in conjunction with content from quadrant 1, is multimedia-based e-learning content like video clips, e-lectures and podcasting. Although the latest technologies sometimes mediate these approaches and help them to be presented in very professional formats, they essentially replicate traditional forms of didactic teaching.

E-learning designs in quadrant 3 attempt to leverage constructivist approaches to engage the learner in real world scenarios and problem-solving. These designs are sometimes expensive to develop, and require an understanding of learning theory, different pedagogical approaches and expertise in educational design. They also typically require some form of facilitation to help scaffold learners' understanding.

Quadrant 4 is the realm of the online facilitator or e-coach who uses social communication tools such as email, discussion forums, weblogs (blogs) and chat (increasingly voice-enabled) to stimulate learning. Social software (particularly voice-enabled tools like Elluminate, Groove, Skype and Wimba) is becoming popular in the corporate world as a way of holding meetings whilst at the same time minimising travel time and expenses. However, learning via social software requires skilled facilitators to engage users and promote interaction. Learning via this medium also requires users to be skilled in Internet technologies.

The contention that many corporate learners require strong direction would indicate that such learners would be most comfortable in quadrants 1 and 2 of Figure 2.1 with some form of face-to-face support. However, more effective learning probably occurs when learners are active participants in the learning process. Quadrants 3 or 4 are ideal learning spaces for such learners. However, learning spaces that require learners to be meta-cognitively, motivationally and behaviourally active in their own learning (Manning & Payne, 1996) may be expensive to develop and maintain and require significant long-term commitment from both employer and employee.

In attempting to encourage contractors to engage with an activity-based learning environment, the Apache Energy e-learning tool encourages independent learning (quadrant 3). However, there are some instructive resources (quadrants 1 and 2) that provide opportunities for contractors to add to their knowledge-base through reading

and/or listening. The environment is learner-driven where contractors have a high level of discretion over the entire experience. Therefore, although the e-learning tool provides a mix between passive and active learning, it calls for a high level of self-directedness. This was embraced by some contractors, but had implications for others and will be discussed further in Chapter 6, Findings - Implementation of the e-learning tool.

2.2.4.3 Application of contemporary conceptions of good practice adult learning principles to a corporate e-learning context

The literature suggests that constructivist approaches to the use of ICTs for learning create the most effective outcomes for students, teachers, employees and employers (Eklund & Kay, 2003; Herrington, Oliver, & Reeves, 2003; Hobbs, 2002; Oliver, 2001). Driscoll (2002) proposes four broad principles that can underpin constructivist learning. These are:

- Learning occurs in context.
- Learning is active.
- Learning is social.
- Learning is reflective.

The application of these principles to corporate e-learning is sometimes problematic. The extent to which the Apache Energy e-learning tool conforms to principles of effective learning will be examined in detail in Chapter 5. However, for the purposes of elucidating this literature review, it is suggested that there is an "uneasy fit", particularly in relation to the social and reflective dimensions of learning. Critics of corporate e-learning may be tempted at this point to draw the conclusion that efficiency factors have triumphed over pedagogical considerations such as encouraging learners to set their own goals or determine their own learning styles. However, it should be acknowledged that corporate learning necessitates the achievement of a diverse range of learning outcomes both knowledge- and skills-based. These learning outcomes may require a range of delivery strategies, some of which are in tune with constructivist notions of learning and some of which are not.

2.3 Summary

This literatures review has summarised current research into corporate e-learning by using three categories to assist in making sense of an array of perspectives:

- Commentaries/contributions on e-learning from the corporate sector.
- Commissioned research into e-learning.
- Critical appraisals of e-learning.

Contributions from each one of these categories have added to the body of knowledge on corporate e-learning. Commentators from the corporate sector generally take a pragmatic view on e-learning design and implementation, and some insights are valuable, particularly for those just beginning to explore e-learning options. However, these contributions sometimes lack rigour, and sometimes can be hampered by conflict of interest. A number of contributors from this category propose blended learning as a useful paradigm for future e-learning implementation. However, blended learning requires a genuine commitment from employers to developing and supporting appropriate learning resources. Decisions about such matters can highlight the tensions between productivity and learning objectives.

Commissioned research into e-learning by government agencies such as the AFL Framework and the NCVER has tended to focus on pedagogical considerations and the extent to which e-learning and online learning are embedded into education and training institutions. This research is informative, but sometimes removed from corporate e-learning situations where return on investment drives decision-making and training budgets.

Finally, critical appraisals of corporate e-learning underline the potential for the application of new learning technologies in the corporate sector, but acknowledge that the different objectives exhibited by employers and employees in the learning partnership can sometimes impact on e-learning designs, implementation strategies and ultimately the quality of learning that takes place.

The literature review reveals a number of contradictions inherent in corporate e-learning. At the root of these contradictions is a conflict between the ethic of productivity and more liberal notions of learning. A focus on the productivity ethic inevitably leads to decisions grounded in notions of return on investment that are integrally associated with profitability. This can lead to e-learning applications that do not fully consider (or choose to ignore) the learning benefits of constructivist pedagogy, particularly those that support longer term and deeper learning objectives. Some workplace learners may themselves reject some principles of constructivism because of the levels of self-directedness that this implies, and the commitment and discipline required to become independent and meta-cognitive learners. Thus, there can be forces at work from both employers and employees that actively militate against the application of constructivist pedagogy in corporate contexts.

It is interesting that the issues, as described above, were all played out during the design, development and implementation of the Apache Energy e-learning tool. There was an acknowledgement that:

- Many learners may not have engaged with formal education and training for a long time, and might need strong direction.
- Learners are mostly contractors, and this did not necessitate a long term commitment to a scaffolding process that would help in a transformation from dependent to independent learners.
- Contractors operate in a time-scarce environment driven by their own considerations of ROI, and therefore may not wish to expend their time on what could be perceived as frivolous activities (e.g. social communication).

There are aspects of the Apache Energy case study that are consistent with the findings of this literature review, and there are aspects that are contradictory. These aspects are unpacked in Chapter 8, Discussion and Conclusion. It is now time to consider the theoretical framework that was used to guide this study and how this might impact on the design of the study and ultimately its findings.

CHAPTER 3
Theoretical Framework

3.1 Chapter overview

This chapter presents the theoretical framework in which the study is set. A cognitive theory of multimedia learning is articulated as a foundation. This theory, drawn from the work of Mayer (2001), examines the mechanics of how learning takes place when interaction with an electronic resource occurs. The chapter then considers the relevance of constructivism, and in particular, Valsiner's (1997) zone theory to provide clues on what compels some individuals to interact with a multimedia resource on a deep level whilst others may regard the resource superficially. The chapter then integrates aspects of the theoretical models espoused by Mayer and Valsiner to show, through two scenarios that are pertinent to the implementation of the Apache Energy e-learning tool, how both cognitive and socio-cultural theoretical traditions can be useful in developing an enhanced understanding of the implementation.

The framework presented acknowledges the complementary aspects of cognitive and socio-cultural theories of learning, and attempts to establish a theoretical lens that is pertinent to the specific conditions of a corporate e-learning context.

3.2 A cognitive theory of multimedia learning

3.2.1 What is multimedia learning?

According to Mayer (2001), multimedia is the presentation of material using *both* words and pictures. Words can be mediated either as text or in audible form. Pictures can be static (e.g. a photograph) or dynamic (e.g. a video clip). The word 'both' is italicised because it is fundamental to Mayer's argument that multimedia learning is potentially more effective than traditional forms of teaching and learning because it taps in to the capacity of a dual channel processing system (visual and auditory input

simultaneously). Reading a book or listening to a lecture typically uses only a single channel.

Mayer suggests that the case for multimedia learning is compelling. Not only can humans receive more instructional material through two channels simultaneously (what he calls the quantitative rationale), we can also learn better:

> …the qualitative rationale is that words and pictures, although qualitatively different, can complement one another and that human understanding occurs when learners are able to mentally integrate visual and verbal representations.
>
> (Mayer, 2001, pp. 4-5)

The Apache Energy e-learning tool is an example of multimedia that uses words and pictures simultaneously in a variety of forms including text, audio, static graphics, animated graphics, video and user-controlled simulations.

3.2.2 Goals of multimedia learning

Mayer's primary concern is on how to develop multimedia materials to enhance human understanding, and he distinguishes between multimedia instructional messages that are aimed at information acquisition and those that are targeted at knowledge construction. The distinction is important in the context of this study.

The rationale of the Apache Energy e-learning tool is to provide basic safety information, and the retention of small chunks of isolated pieces of information is seen as a valid educational outcome. The assessment component of the e-learning tool is aimed at discerning whether contractors have retained information through multiple choice, true/false and "drag and drop" questioning (an example is provided as Figure 3.1).

Although the primary objective of the e-learning tool is to provide contractors with the opportunity to demonstrate an understanding of basic safety information, the formative learning component of the tool adopts quizzes as an interactive strategy where the feedback is an important component of the learning process (an example is provided as Figure 3.2). Therefore, although the goal of the e-learning tool is explicitly aimed at information retention, the design of the tool also implicitly seeks

to help contractors make connections between concepts and assist them to develop knowledge structures (e.g. establish cause and effect chains) which are fundamental to knowledge construction.

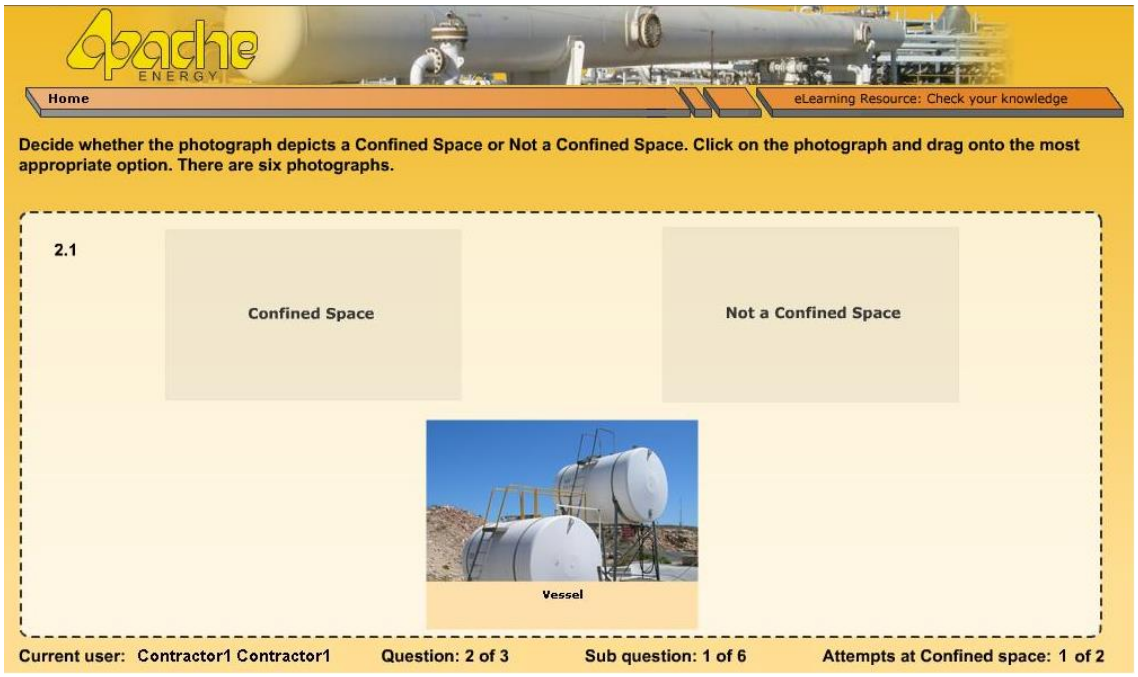


Figure 3.1. **Example of a confined space assessment item in the Apache Energy e-learning tool**.

Questioning in the assessment component of the Apache Energy e-learning tool is aimed at ensuring that contractors can demonstrate their understanding of what Apache Energy would consider to be uncomplicated safety policies, procedures and practices. In the example cited in Figure 3.1, contractors are simply required to recognise what constitutes a confined space (in this case a vessel).

In Figure 3.2, other related concepts are identified via the feedback provided. For example, the fact that toxic gases can be heavier than air and can accumulate in spaces that are below the level of the ground.

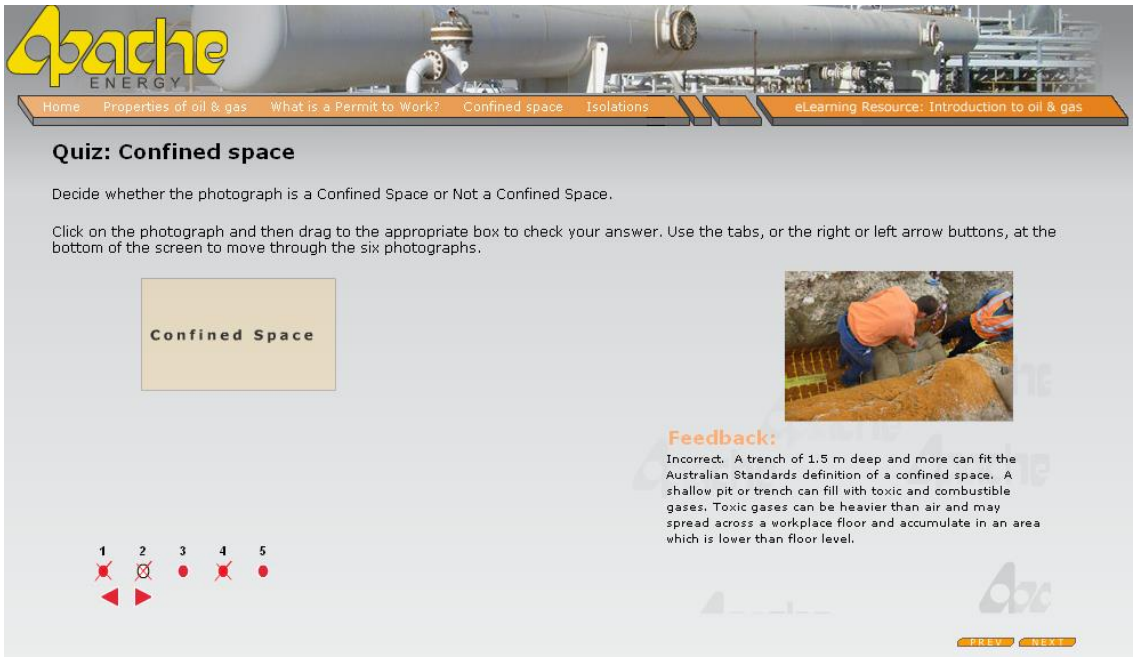


Figure 3.2. **Example of a confined space formative learning item in the Apache Energy e-learning tool.**

For the e-learning tool to explicitly measure knowledge construction an assessment task focused on knowledge transfer rather than information retention would be required. For example, the following question would require a contractor to think of a confined space both in terms of its physical characteristics, but also in terms of gases that are present and/or oxygen deficiency:

> Suppose someone enters a confined space and conducts a work task satisfactorily without incident. Why did this occur? What makes a confined space potentially dangerous?

This form of questioning is attractive in that it requires contractors to think about multiple risk factors. However, there are implications in terms of the human resources required to assess the quality of responses. Apache Energy opted for a low cost assessment method that tested information retention, but ensured that the e-learning tool was built so that higher order thinking and knowledge construction were possible. The goal of the e-learning tool, therefore, is both to deliver information (desired learning outcomes) and to provide cognitive guidance so that contractors make sense of the information provided, inside and outside of the software environment (unplanned learning outcomes).

One of the interesting dimensions of this study is to gauge the extent to which knowledge construction can occur despite assessment being oriented towards information retention. This issue will be examined in Chapter 7, Findings: Outcomes to emerge.

3.2.3 Assumptions of a cognitive theory of multimedia learning

There are three assumptions that underpin Mayer's (2001) cognitive theory of multimedia learning. The first, as previously discussed, is that multimedia learning is a *dual channel activity*. That is, humans have separate channels for processing visual and auditory information. This assumption does not infer that equal weight is afforded to visual and auditory channels, only that when they are used together, a potential for deeper learning emerges.

The second assumption - *limited capacity* - involves an understanding of how the human mind works. Figure 3.3 shows Mayer's cognitive theory as a relationship between the sensory memory, the working memory and the long term memory.

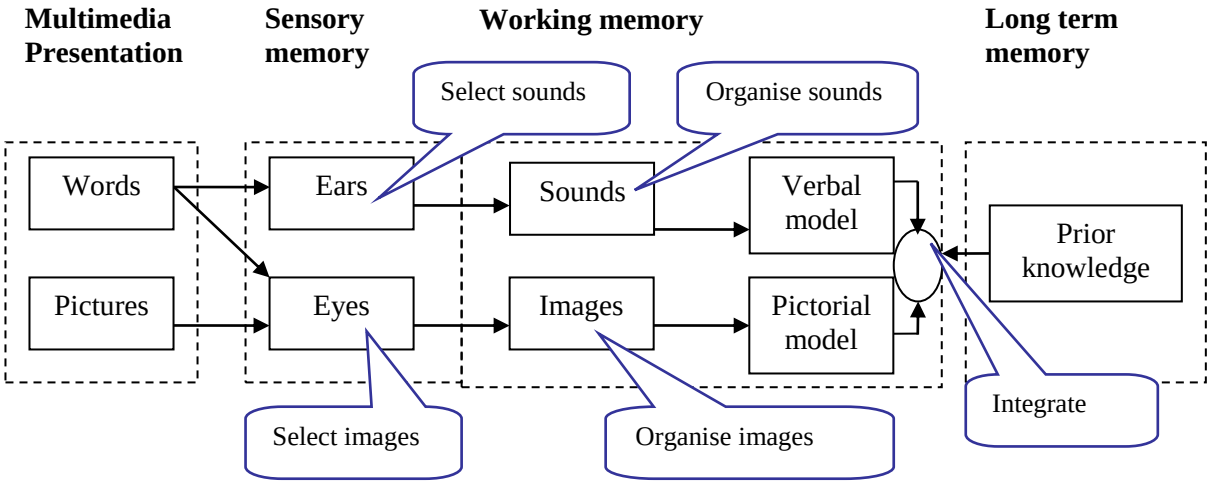


Figure 3.3. **Cognitive theory of multimedia learning drawn from Mayer (2001, p. 44).**

Visual and auditory information is held in the sensory memory for a very short period of time. Sounds and images are selected from this sensory input and held in the working memory. It could be argued that it is at this point that the knowledge construction process begins. The very act of selecting sounds and images that are

worth dealing with in the working memory implies some level of interest and engagement on the part of the learner.

According to Mayer (2001), the working memory is where cognitive activity takes place. Mental models, both verbal and pictorial are developed and integrated with prior knowledge that is held in the long term memory. The problem with the working memory is that it has a limited capacity. Humans have a "cognitive load" which is determined by how difficult they perceive the instructional message to be, and how they respond to the way in which the instructional message is presented.

The issue of cognitive load is particularly important in the case of the Apache Energy e-learning tool where, for many contractors, computer and safety understandings are competing for cognitive resources. In saying this, the Apache Energy e-learning tool is segmented into small manageable instructional messages that typically include a presentation, a real world application, relevant safety hints and an interactive quiz. This design was purposeful in that Apache Energy did not wish to overload contractors who were new to the oil and gas industry. However, there is a chance that some contractors may be so challenged by literacy and/or computer literacy issues that learning may be difficult without facilitation. Equally, there is a risk that, without providing opportunities for experienced contractors to be challenged (e.g. by posing ill-defined problems or by assigning leadership roles within small groups), that this cohort of contractors will become disengaged with the e-learning tool because of its inability to offer anything new. This scenario is examined in Chapter 8, Discussion and Conclusion.

The third assumption, which Mayer (2001, p. 50) describes as *active processing*, posits that "humans actively engage in cognitive processing to construct a coherent mental representation of their experiences". In other words, when we engage with an instructional message we have the opportunity to select, organise and integrate the information contained in the message with other knowledge held in our long term memory. The way in which we make sense of an instructional message is to construct coherent mental knowledge structures. According to Cook and Mayer (1988), these structures can take a variety of forms. Some examples include:

- Development of cause and effect chains.
- Comparison of elements or concepts.
- Classification of elements into hierarchies.
- Development of relationships between elements or concepts (e.g. mind maps).

The extent to which instructional messages are consistent, or in conflict, with the learner's prior knowledge has the potential to affect the level of cognitive activity that occurs in the working memory. If the instructional message is already known and understood, then the level of cognitive activity is likely to be low with the instructional message being quickly integrated into the long term memory. This has implications for the Apache Energy e-learning tool where, according to Apache Energy, some contractors were already experienced in working in oil and gas environments and had well developed safety understandings.

As discussed, the assessment in the Apache Energy e-learning tool was about retention of information. It did not attempt to unpack the mental knowledge structures of contractors. The impact of this decision is considered in Chapter 8, Discussion and Conclusion.

A cognitive theory of multimedia, such as that delineated by Mayer (2001), is particularly useful for research into corporate e-learning because it helps to explain the mechanics of learning independently with a computer-based learning tool. However, the Apache Energy e-learning tool was implemented in an e-learning centre with some social support mechanisms provided both in the centre and on-site. Furthermore, the level of expertise in oil and gas safety procedures held by the users of the e-learning tool, varied from novice to professional. It is, therefore, equally useful to examine how the socio-cultural context can impact on an e-learning setting. This necessitates a consideration of the constructivist theory of learning.

3.3 Constructivism

3.3.1 Making meaning

Like Mayer's cognitive theory of multimedia, the constructivist tradition holds that learning is an active process of integrating new information and experiences into existing understandings, revising and re-interpreting old knowledge in order to reconcile it with something new (Billett, 1996). This definition has its roots in the work of Piaget (1963) who argued that, because the process of making meaning is internalised in our own minds, it is an inherently individualistic pursuit; a process of autonomous discovery brought about through meaningful engagement with our environment. Because the focus of learning is the internalisation of new information, how it is mediated (e.g. socially through classroom discussion, or individually through engagement with technology or a book) is secondary. Learning occurs when people make sense of new information and experiences, and this can only occur in our own heads.

Conversely, Vygotsky (1978) proposed that all learning is created, assembled and maintained within a socio-cultural context, arguing that learning is so deeply embedded in social structures (e.g. language), that it is impossible to conceive it as autonomous discovery. This research takes a theoretical position that important psychological *and* socio-cultural processes occur in learning and development (Hung & Nichani, 2001). Vygotsky himself, (quoted in Valsiner, 1997, p. 149), understood and embraced both the socio-cultural and psychological processes:

> The crucial characteristic of instruction is the fact that instruction creates the zone of proximal development, i.e. elicits in the child, promotes, and brings to movement a number of internal development processes, which at the present time are available for the child only in the sphere of relations with the people around and in joint action with peers, but which later, undergoing [an] internal course of development, become the internal property of the child himself.

The theoretical framework presented here acknowledges that learning fundamentally involves internalising information and experiences drawn from the external environment. However, it also examines how Vygotsky's Zone of Proximal Development (ZPD) comes into play in a corporate e-learning context.

3.3.2 The Zone of Proximal Development

The ZPD, as defined by Vygotsky (1978, p. 86) is a gap between:

> The actual developmental level as determined by individual problem-solving and potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers.

The ZPD is an important concept because it affords a crucial role for the socio-cultural context of learning. On face value, the above definition would suggest that Vygotsky views adult guidance or collaboration with more capable peers as a necessary condition for learning. However, Vygotsky (quoted in Valsiner, 1997, p. 149) also acknowledged that children can construct a ZPD for themselves in the process of play:

> The play creates the zone of proximal development for the child. In the play the child is always above his average age, above his usual everyday behaviour; in the play he is as if as head-high above himself. The play contains in a condensed way, like the focus of a magnifying glass, all tendencies of development; in play the child tries as if to accomplish a jump above the level of his ordinary behaviour.

If children can conduct a ZPD in the process of play, it could also be inferred that adult learners could also construct their own ZPD, for instance, by interacting with a simulated multimedia environment (e.g. simulating roles and behaviours in which they may be unfamiliar with in everyday life). This thesis adopts this neo-Vygotskian perspective of the ZPD arguing, as Valsiner does, that the ZPD is:

> A set of possibilities for development that are in the process of becoming actualised as individuals negotiate their relationship with the learning environment and the people in it.
>
> (Valsiner quoted in Goos, 2006, p. 3)

"Possibilities for development" are exclusive to each individual. In the first instance, these possibilities depend upon the relationship between current levels of knowledge and the knowledge "on offer" in the learning environment. In the case of the Apache Energy e-learning tool, if a contractor's current level of knowledge about workplace safety exceeds that which is provided through the process of engaging with the e-learning tool, then the possibilities for development are limited. The potential for the contractor's ZPD to be aroused through interacting with the e-learning tool is

low, although some reinforcement of existing learning is a likely outcome. If, on the other hand, the contractor has a basic knowledge of workplace safety, but this has been acquired primarily through working in the building industry (rather than the resources industry), then there is a chance of learning something new. In this circumstance, there is a greater potential for the e-learning tool to stimulate and support a contractor's ZPD.

Another factor that influences an individual's ZPD is their motivations for learning (Jones & Byrnes, 2006). If learning is perceived as an irritation, in the case of Apache Energy something that has to be done in order to get on site, then the possibilities for development are diminished. If, on the other hand, a contractor has a genuine interest in workplace safety believing that it is *the* most important consideration in any workplace, then the contractor's ZPD has the potential to be aroused through engaging with the e-learning tool because there is a chance of learning something important.

The content "on offer" is one aspect of the learning environment that affects an individual's ZPD. Another important consideration is the person's beliefs about learning itself (Aleven, Stahl, Schworm, Fischer, & Wallace, 2003). Each person comes to a learning experience with her/his beliefs about what formal learning actually is, and the value that should be afforded to it. These beliefs have emerged through an association with learning that probably has its roots in schooling experiences, possibly followed by post-compulsory education and training, and finally workplace learning experiences. If these experiences have been problematic for the individual, then her/his attitude towards learning may be unenthusiastic. In this case, an individual's self-efficacy about the learning process itself may be a significant barrier.

Learning flexibly with, and through ICTs adds another level of complexity to an individual's self-efficacy about learning (J.A. Davies, 2002). Many contractors are used to a didactic approach to learning and are taken aback when they are asked to be active in their own learning and engage with an e-learning tool. On the other hand, for busy contractors, the opportunity to work at their own pace is sometimes seen as a highly attractive option. If an individual has had a bad experience with computers,

or has never used a computer before, then it is likely that the individual may exhibit fear and trepidation if he/she was suddenly asked to engage with an e-learning tool. Overcoming this fear may be a pre-cursor to exploring the possibilities for development.

Four scenarios are developed in Chapter 8, Discussion and Conclusion, to illustrate how factors of prior knowledge, motivations for learning, experiences of learning, and experiences of using computers can come into play to affect an individual's ZPD and ultimately the learning that takes place.

3.3.3 Valsiner's zone framework

The ZPD is an important theoretical construct in the context of this study. However, its focus is on understanding the individual and/or the impact of peers in stimulating learning and development. In an adult learning environment, there are other forces and conditions that impact upon learning. For example, with regard to the physical environment it is important to ensure that the computers work and the e-learning tool is understandable. If the hardware and software are appropriate and well designed, then the possibilities for development have more chance of being realised (Goos, 2006). Equally, an organisational culture that recognises and values knowledge generation and sharing creates an environment that is conducive to learning. It is, therefore, useful to consider other physical and socio-cultural conditions that may impact on learning and development. Valsiner (1997) proposes two other zones that may serve to better understand how the ZPD can operate in a specific socio-cultural context (in this case, corporate e-learning):

- The Zone of Free Movement (ZFM); and
- the Zone of Promoted Action (ZPA).

Valsiner (1997) uses these zones to build a theoretical construct to help explain relationships between culture and the development of actions. In essence, the zones create a picture of the physical and socio-cultural space in which a contractor's ZPD is situated. This thesis applies Valsiner's theory to the implementation of the Apache Energy e-learning tool in an attempt to explain behaviours and actions of participants within this context.

3.3.3.1 The Zone of Free Movement (ZFM)

Valsiner's (1997) ZFM defines learning-environment relationships (e.g. what is to be learnt, where, when and how the learning takes place). In the case of the implementation of the Apache Energy e-learning tool, the ZFM is:

- The e-learning centre.
- The computers and software within the e-learning centre.
- Other infrastructure within the e-learning centre (e.g. telephone).
- The e-learning tool, including its activities, resources and assessment.
- Administrative and technical services that support the e-learning centre.

3.3.3.2 The Zone of Promoted Action (ZPA)

In the context of this study, the ZPA comprises forces that seek to drive learning. Valsiner (1997, p. 192) describes the ZPA as "a set of activities, objects or areas in the environment in respect of which the person's actions are promoted". In the case of the implementation of the Apache Energy e-learning tool, the ZPA is defined by the socially mediated norms of behaviour, rules, guidelines and incentives that exist at the e-learning centre which ultimately promote activity on behalf of the contractor. These include:

- Messages from contracting agencies that caused contractors to attend the e-learning centre in the first place.
- Messages (explicit and implicit) designed to persuade contractors to accept the learning environment (e.g. "you need to do the induction before being allowed on site", "this is the way it's done at Apache Energy", "safety is important at Apache Energy" etc.).
- Explicit behaviours that persuade contractors to engage with the e-learning tool (e.g. the e-learning centre flowchart, the introduction by the e-learning centre administrator).

- Other social forces (e.g. other contractors already engaging with the e-learning tool).

3.3.3.3 Scenarios to illustrate Valsiner's zone framework

Two hypothetical scenarios are now interpreted using Valsiner's (1997) zone theory. This interpretation provides a practical understanding of how this theory can be used to explain the effects of the implementation of the e-learning tool on the contractor's learning. To illustrate these scenarios, it is useful to adopt the metaphor of a road trip with the ZPA symbolising the road, and the ZFM the scenery around the road. The journey taken, including any observations of the scenery represents the ZPD.

Scenario 1 (Figure 3.4) shows how a contractor with limited knowledge of safety in the oil and gas industry is likely to respond to the e-learning tool.

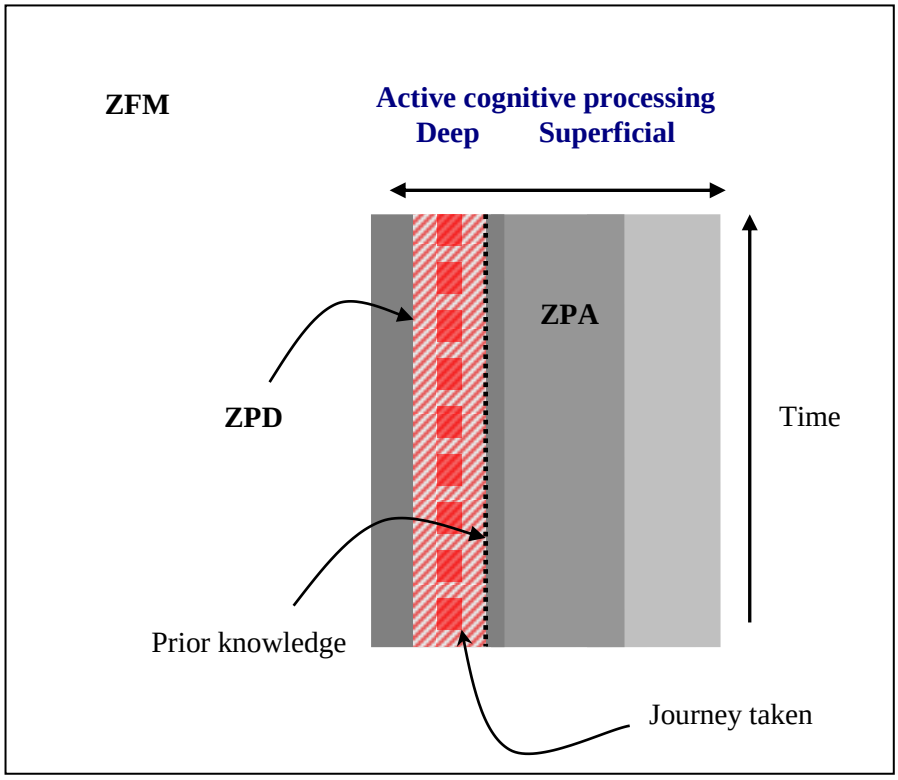


Figure 3.4. **Relationship between Valsiner's ZFM and ZPA in the case of a contractor with limited knowledge of safety practices in the oil and gas industry.**

This contractor, who is inexperienced in safety procedures in the oil and gas industry, is likely to have strong possibilities for learning. The contractor's interaction with the e-learning tool, denoted by the dotted line in Figure 3.4, intersects with her/his ZPD.

There are two primary reasons for drawing the conclusion that that this may stimulate possibilities for learning, both of which are related to Valsiner's ZPA and ZFM zones:

- The contractor is prepared to operate within the ZFM - the contractor accepts the learning process (i.e. using a computer to learn in the e-learning centre in a self-paced manner is appropriate).
- The contractor's prior knowledge resonates with the ZPA - the contractor's current understandings are such that he/she accepts that engaging with the e-learning tool is important because there is an acknowledgement that (a) safety is an integral component of functioning in the workplace and (b) that the safety induction is a critical step in being able to work with Apache Energy.

If the contractor satisfies these conditions, then it is likely that he/she is open to a deep level of active cognitive processing. To draw upon the metaphor of a road trip, the vehicle will be in the slow lane and the journey will be interesting and satisfying to the driver.

Scenario 2 (Figure 3.5) predicts how a contractor with extensive knowledge of safety practices in the oil and gas industry is likely to respond to the e-learning tool.

This contractor, who is experienced in safety procedures in the oil and gas industry, is likely to have limited possibilities for learning through engaging with the e-learning tool. The contractor's interaction with the e-learning tool, denoted by the dotted line in Figure 3.5, does not intersect with her/his ZPD. Although the contractor accepts that safety is important and that the safety induction is a critical step in being able to work with Apache Energy, he/she has a perception (real or otherwise) that the e-learning tool cannot offer anything new - the contractor already knows about safety practices and procedures in the oil and gas industry.

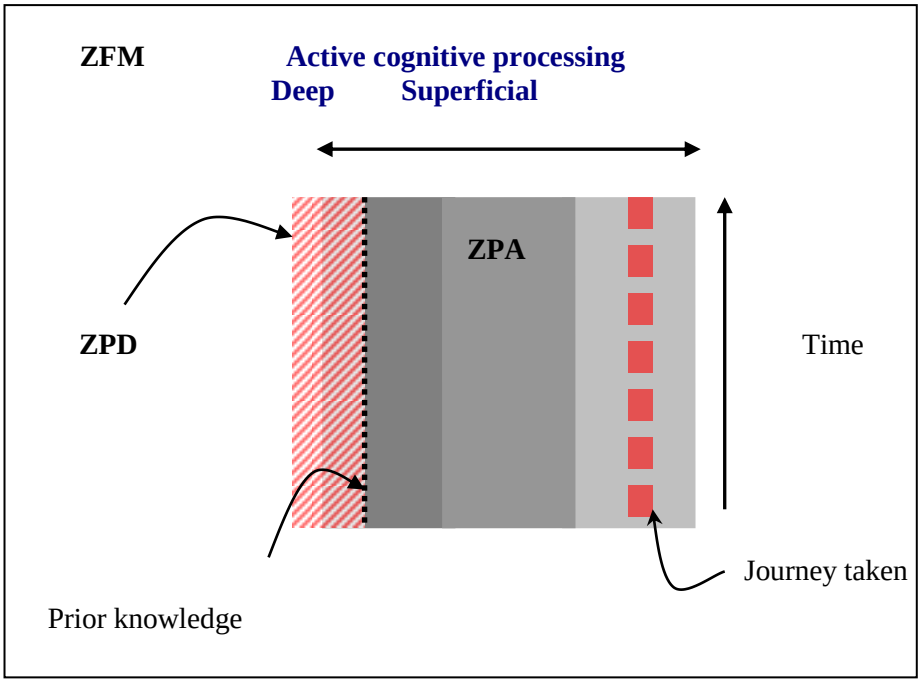


Figure 3.5. **Relationship between Valsiner's ZFM and ZPA in the case of a contractor with extensive knowledge of safety practices in the oil and gas industry.**

In the circumstances outlined in Figure 3.5, the intervention of a teacher introducing more challenging activities may stimulate learning at a deeper level. However, if the expected learning outcomes are targeted at basic safety understandings, then teacher intervention may be seen as unnecessary by both Apache Energy and contractors. A superficial level of active cognitive processing may be seen as acceptable for experienced contractors. The e-learning tool thus takes on a slightly different function of being a potentially efficient way of fast-tracking contractors through the safety induction process.

To use the metaphor of a road trip again, the journey was short. The driver did not take much notice of the scenery mainly because the vehicle was driven in the fast lane. However, the journey was satisfying to the driver precisely because of its brevity.

The zone framework, as described above, provides a useful mechanism for understanding why some contractors are attracted to the Apache Energy e-learning tool, and some reject or circumvent it. The extent to which the contractor is motivated by the attributes of the learning process (the ZFM), and her/his disposition to the learning that is on offer (the ZPA) sets an important socio-cultural context in which the contractor's ZPD is situated. The zone frameworks thus could provide

clues as to why people engage with the e-learning tool on superficial or deeper levels. These issues will be considered in detail in Chapter 8, Discussion and Conclusion.

3.4 Summary

This chapter has attempted to set the study in a theoretical framework that will enable the findings to be both understood and meaningfully interpreted. The research considers learning in both cognitive and constructivist theoretical paradigms, and uses a combination of Mayer's (2001) theory of multimedia learning and Valsiner's (1997) neo-Vygotskyian zone framework to help understand how Apache Energy contractors have responded to the Apache Energy e-learning tool.

The application of the theoretical framework to this study helps to better understand and interpret the actions of contractors in their responses to the e-learning tool and its implementation. For this reason, the theoretical framework is re-visited in Chapter 8, Discussion and Conclusion.

The next chapter introduces the methodology that was adopted to conduct the study.

CHAPTER 4
Methodology

4.1 Chapter overview

The development of the research methodology that underpins this thesis resembles Shulman's (1988) thinking that disciplined inquiry should first understand the problem, secondly decide which questions are worth asking and thirdly, select the appropriate method in response to those questions. In keeping with this framework, this chapter will articulate the problem, pose the research questions that will attempt to inform and confront the problem and then describe the epistemological framework in which the study is set. It will also provide a detailed description of the research design, approach and methods used to collect and analyse data. Finally it will consider the role of the researcher, the limitations of the research and the ethical conduct of the study.

4.2 The problem

Organisations seeking to develop an e-learning implementation strategy may need to consider:

- Possible contradictions between the ethic of productivity and more liberal notions of learning.
- The forces at work, from both employers and employees that sometimes actively militate against the application of contemporary learning theory (e.g. constructivist pedagogies) in corporate e-learning contexts.
- The lack of evidence-based research that can be applied to inform the corporate sector on effective e-learning design and implementation.

The combined effect of these conditions is that typically, the design, development and implementation of e-learning fails to satisfy employers and employees and can result in wastage of resources and questionable learning outcomes.

The following research questions are posed to encourage a greater depth of understanding of how e-learning is implemented in a specific corporate context.

4.3 Research questions

Three primary research questions have guided the study, namely:

1. What design principles underpin an e-learning tool developed for an oil and gas organisation in the area of workplace safety?

2. How has this e-learning tool been implemented in an oil and gas organisation?

3. To what extent does the implementation of the e-learning tool achieve desired outcomes?

These research questions are discussed below.

4.3.1 Design principles underpinning the e-learning tool

Research question 1 – *What design principles underpin an e-learning tool developed for an oil and gas organisation?* – will be addressed by describing the structure and features of the e-learning tool in relation to established features of effective educational design. Consideration is also given to contractors' perceptions of the e-learning tool.

4.3.2 Implementation of the e-learning tool

Research question 2 – *How has this e-learning tool been implemented in an oil and gas organisation?* – will be addressed by describing the implementation of the e-learning tool at Apache Energy.

The study explores implementation practices with particular attention on two sub-questions:

i. How did contractors interact with the e-learning tool?

ii. To what extent did the implementation complement the design of the e-learning tool?

4.3.3 Relationship between implementation practices and outcomes

Research question 3 – *To what extent does the implementation of the e-learning tool achieve desired outcomes?* – will be addressed by first re-capping on the desired outcomes that were expected by Apache Energy. It then describes the outcomes that emerged at the site. Finally, it attempts to unpack whether these outcomes were desired outcomes and/or unplanned learning outcomes. In doing this, the study examines the features of the implementation that influenced these outcomes. The following four sub-questions help to inform research question 3:

i. What were the desired outcomes to emerge?

ii. What were the unplanned learning outcomes (if any)?

iii. What were the features of the implementation that influenced achievement of desired outcomes?

iv. What were the features of the implementation that influenced achievement of unplanned learning outcomes (if any)?

4.4 Epistemological framework

4.4.1 Qualitative and quantitative research traditions

This research is about exploring e-learning implementation practices in a corporate learning setting in the resources sector, specifically oil and gas. To attain a deep understanding of the learning environment, and the actions of contractors, safety

advisers, managers and administrative staff, an interpretive case study framework, within the qualitative research tradition is proposed (shaded in Figure 4.1).

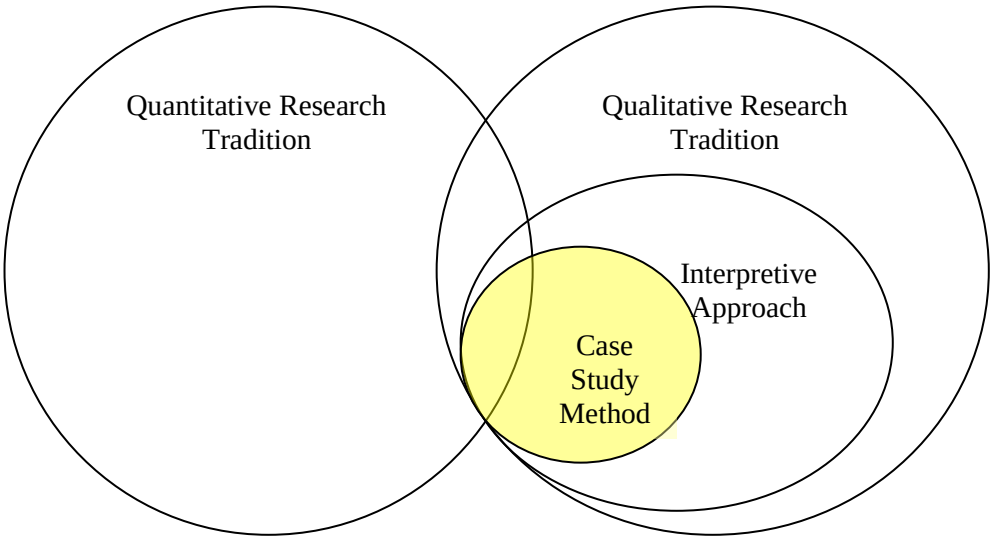


Figure 4.1. **Interpretive-case study framework for the research.**

The study is situated in the qualitative research tradition, although quantitative data was also collected. It is pertinent here to distinguish between qualitative/quantitative research *traditions* and qualitative/quantitative data collection. The former relating to a broader philosophical position in the relation to the nature of knowledge, and the latter referring to the methods used to collect data. It is generally accepted that an appropriate mix of quantitative/qualitative data collection methods is a useful way of strengthening research, despite underlying assumptions of these traditions about the validity of findings (Sturman, 1994).

The qualitative research tradition, which emerged with the development of the social sciences, seeks to understand and explain social phenomena. Key features of the research process are openness, honesty, acknowledgement of subjectivity, auditability, credibility and fittingness (Guba & Lincoln, 1981). Merriam (1988, p.5) describes the qualitative research tradition as overarching, encompassing several forms of inquiry:

> Qualitative research is an umbrella concept covering several forms of inquiry that help us understand and explain the meaning of social phenomena with as little disruption of the natural setting as possible.

Merriam's (1988) umbrella conception of the qualitative research tradition fits comfortably with this research, which adopts a case study method using an interpretive lens. The use of these terms, within the context of this study, is described more fully below. However, it is first necessary to explore why the qualitative research tradition is attractive to studies in education, and more specifically to new innovations like e-learning.

4.4.2 Qualitative research – Description and explanation

Workplace learners bring their own histories to the learning setting and these, in turn, potentially influence the level of learning that takes place. In these complex social environments, groups are formed (classes, workshops, tutorials, teams, intakes of inductees etc), and these groups sometimes develop their own identities and dynamics. Salomon (1991, p.11) characterises classrooms as:

> …complex, often nested conglomerates of interdependent variables, events, perceptions, attitudes, expectations and behaviours…

Description of what happens to individuals in groups that come together in a particular setting to learn is seen as a valid research aim. *Explanation* is perhaps a little more difficult because it brings with it a subjective dimension where the researcher is called upon to interpret phenomena. However, with care, an acknowledgement of the subjective nature of research should not necessarily reduce its credibility (Merriam, 1998).

The value of descriptions and explanations outside of the context from which they are situated, is the source of some debate between quantitative and qualitative researchers. Researchers from the quantitative tradition will typically focus their energies on generalisability (Blaxter, Hughes, & Tight, 1996; Burns, 2000) and reproducibility (Denzin, 1994). Drawing inferences from small populations that can be applied to larger populations as a way of solving problems, building theory or improving performance is the business of the quantitative researcher. The emphasis is on the "objective" collection and analysis of data and the elimination of bias. Tools used in this quest include systematic testing of hypothesis, experimentation and measurement through statistical analysis.

Fundamentally, the qualitative research tradition rejects the notion that an objective reality is "out there" waiting to be discovered. Rather, reality is something that is constructed by individuals through the process of interacting with their social worlds (Merriam, 1998).

The decision to adopt a qualitative framework in this research is grounded in a belief that such an approach will most adequately respond to the requirements of the research questions that underpin the study. The research questions are posed to encourage a greater depth of understanding of how e-learning is implemented in the resources sector; they are not designed to prove or disprove educational theories or phenomena, or predict outcomes in similar settings.

The complexity and uniqueness of teaching and learning exchanges both within institutions and in industry settings suggests that generalisability and reproducibility are difficult to achieve in practice. Eisner (1979, p. 185) recognizes this, arguing that approaches emphasizing objective, value-free inquiry, where participants are perceived to act in logical and measurable ways - what he describes as traditional educational research - has proven to provide an altogether too "slender slice of educational reality".

This research seeks to explain as well as describe; it proposes semi-structured data collection techniques; and it suggests systematic analysis of verbal narrative. In short, it will have a level of rigor that will enable it to be situated as part of a larger knowledge base that seeks to explain what constitutes successful e-learning in corporate contexts. In Merriam's vernacular (1985), it will strive to be credible and confirmable. However, it makes no explicit claims to be generalisable outside of the context in which it is set.

4.5 Approach and methods used

4.5.1 Interpretive approach

The study's research questions are designed to provide insights and understanding of an e-learning implementation with the focus on enhancing knowledge of implementation practices, unpacking what learning takes place as a result of engaging with a specific e-learning tool. In this environment, an interpretive approach, seeking to create the conditions for the collection of "rich, thick" data (Merriam, 1988) that are ripe for description and explanation, is most appropriate.

Neuman (2003, p. 76) provides a working definition of the interpretive approach to conducting social research:

> …the systematic analysis of socially meaningful action through the direct, detailed observation of people in their natural settings in order to arrive at understandings and interpretations of how people create and maintain their social worlds.

This definition acknowledges the subjectivity of research that is cast in an interpretive paradigm, however, it also highlights that this should not constitute a concession of lack of rigor. Systematic analysis and detailed observation suggests that the interpretive researcher may require a different set of skills and capabilities than, for example, those that may have been useful for the empirical-analytical researcher in the positivist tradition. For instance, perceptiveness and knowledge of the subject matter will help the researcher to ask probing questions that will enhance overall understanding.

Tobin and Fraser (1998) argue that the appropriate use of the interpretive method has made an important contribution to the development of knowledge about pedagogy in recent times. Consideration of underlying emotions, sentiments, attitudes, opinions and motivations, and not just actions in isolation, generates enhanced understanding. Careful consideration of these aspects often necessitates the use of the case study method.

4.5.2 Case study method

Yin (1994, p. 13) describes a case study as:

> …an empirical inquiry that investigates a contemporary phenomenon within its real life context, especially when the boundaries between phenomenon and context are not clearly evident.

Case study research strives for understanding through in-depth description of circumstances, individuals and communities (Neuman, 2003). Sturman (1994) sees the distinguishing feature of case studies as a social group that develops its own characteristics (e.g. wholeness) where these characteristics are not simply a loose collection of individual behaviours.

There is some debate in the literature into what constitutes a case study approach. Eisenhardt (1989) argues that research involving multiple case studies facilitates more fruitful theory generation, suggesting that between 4 and 10 cases usually work well. Stake (1994) contends that one of the distinguishing characteristics of a case study is its specificity and uniqueness. Dyer and Wilkins (1991) believe that single- and multi-site case studies both have a place in social research. However, Dyer and Wilkins warn that "the more contexts a researcher investigates, the less contextual insight he or she can communicate" (1991, p. 634).

This research will examine the implementation of an e-learning tool at a single site at Apache Energy in Western Australia, where individuals being inducted into the facility and staff managing/administering the implementation define the case. The study was conducted between May and December 2005.

The case study was selected according to the following criteria:

- The e-learning tool appeared to conform to educational standards that encouraged learners to construct understandings through engaging activity-driven resources.
- The e-learning tool was offered to viable numbers of participants.

- The organisation that implemented the e-learning tool was supportive of the research, and management/administration staff members were willing to take part.

Data collection at the case study site was undertaken at macro and micro levels. Macro level data refers to the entire sample: the total number of participants that engaged with the Apache Energy e-learning tool between May and December 2005. Micro-level data refers to those who agreed to be observed and/or interviewed at three intensive data collection periods at the e-learning centre. The numbers of macro and micro study participants are provided in Table 4.1

Table 4.1:
Number of Participants Involved in the Research at Case Study Site May-December 2005

Year	**Contractors**		**Safety Advisers**	**Managers/ Administrators**
2005	Micro study	Macro study	2	2
	27	256		

Between May and December 2005, 256 contractors interacted with the e-learning tool at a dedicated e-learning centre at time which suited them. The number of participants attending the centre was dependent on the work that was required at the Apache Energy oil and gas plant at any particular point in time. Figure 4.2 shows the number of participants that attended the e-learning centre during each month between May and December 2005. It also indicates the periods of data collection in June, August and October 2005 that were required for the micro study (shaded).

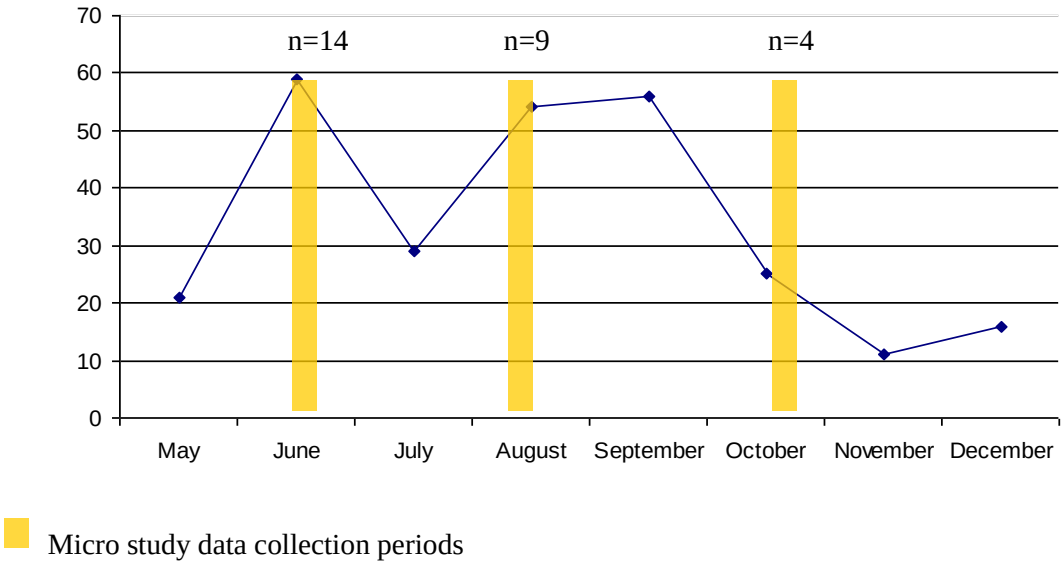


Figure 4.2. **Number of participants attending the e-learning centre (May-December, 2005) in relation to micro study data collection periods.**

For the micro study, data on learners' ages, gender, experience in using computers, and perceptions of the e-learning experience were collected via a questionnaire and follow-up interviews.

The majority of individuals that attended the e-learning centre were skilled workers/ technicians, supervisors/managers/inspectors or other professionals (see Table 4.2). All were contractors.

Fifteen Apache Energy employees engaged with the tool. These were removed from the sample for two reasons. Firstly, they all had supervisory rather than operational responsibilities (unlike contractors who generally were operational). Secondly, no Apache Energy employees were available during micro data collection periods for interview or observation, and no Apache Energy employee completed the questionnaire. With no qualitative data on employees, it was deemed sensible to remove the 15 individuals from the research.

Table 4.2:
Occupational Profile of Contractors that Attended the e-Learning Centre Between May and December 2005

Occupation	Number	Per cent
Electrician/Electrical Technician	36	14%
Dogman/Rigger/Scaffolder	24	9%
Boilermaker/Welder	19	7%
Painter	18	7%
Pipe Fitter	16	6%
Service Technician	16	6%
Managers/Engineers	16	6%
Trades Assistant	15	6%
Installers	10	4%
Supervisors	8	3%
Inspector	7	3%
Professional (Chemist, Environmental Scientist, Biologist)	7	3%
Mechanic/Mechanical Fitter	7	3%
Other	57	23%
	256	100%

Agencies that provided the largest number of contractors operated in the areas of pipe fabrication and construction, although one agency provided specialist skills in electrical and instrumentation work. Dogmen, riggers, scaffolders and painters tended to come from a variety of smaller agencies. Out of the 256 contractors that engaged with the e-learning tool, 253 were male and 3 were female. The females were contractors working in environmental science, surveying and administration occupational categories.

4.5.3 Research design

The study was broken down into three phases:

1. Analysis of the e-learning tool.
2. Description of the implementation of the e-learning tool.
3. Explanation of the outcomes to emerge as a result of the implementation of the e-learning tool.

The rationale for each of the three research phases, along with their relationship to the study's research questions are described in Table 4.3.

Table 4.3:
Phases of the Research

Phase	Rationale for phase	Relationship to research questions
1. Analysis of the e-learning tool	Gauge the quality of the design of the e-learning tool.	1
2. Description of the implementation of the e-learning tool	Provide a description to enhance understanding of how the e-learning tool is implemented at the case study site.	2
3. Explain the outcomes to emerge as a result of the implementation of the e-learning tool	Enhance understanding of how the e-learning tool contributes to desired outcomes at the case study site by explaining possible relationships.	3

Figure 4.3 shows the timeline within which the research was conducted.

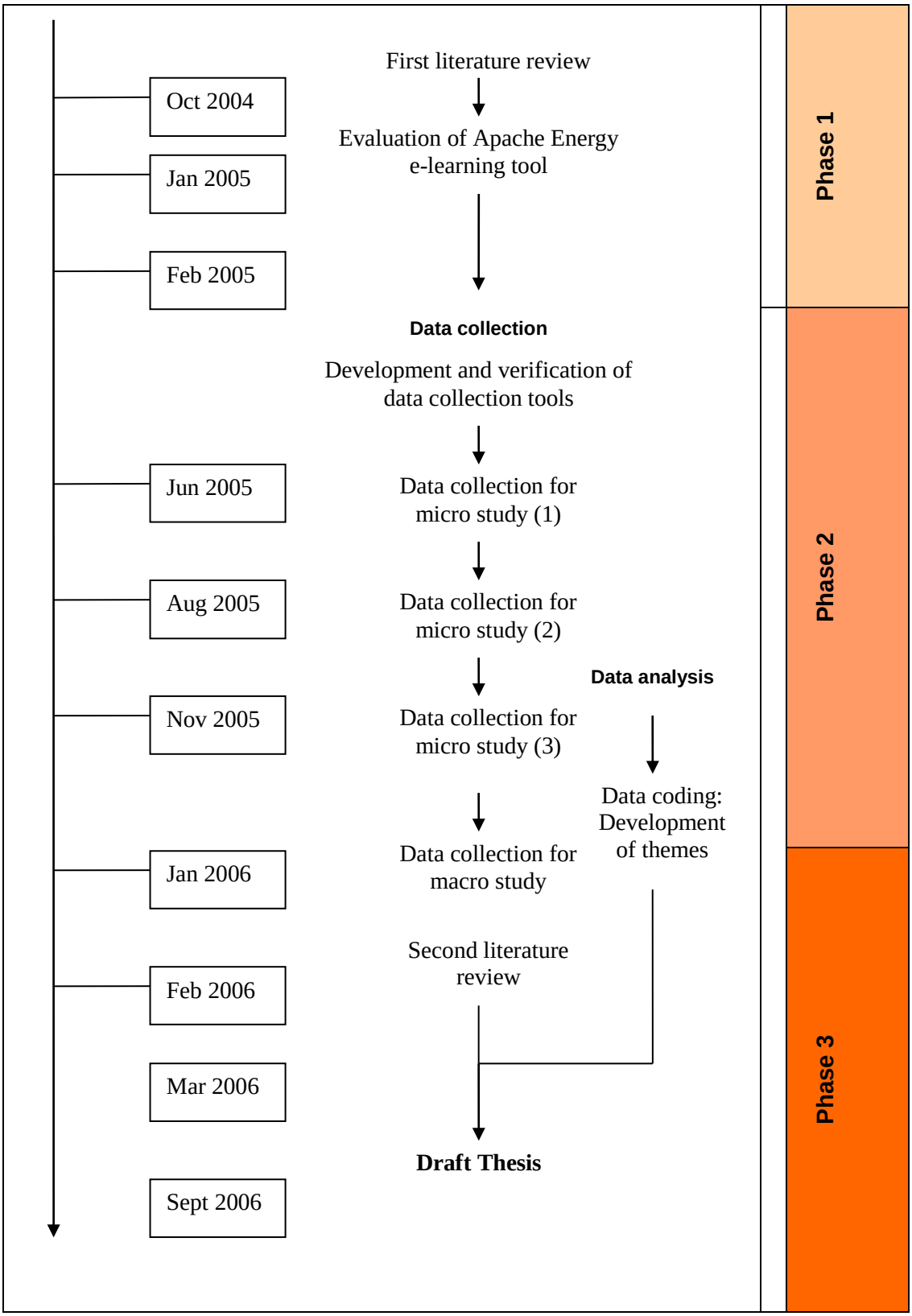


Figure 4.3. **Timeline for the research.**

The three phases of the research acted as a "road map" for the study. These are now discussed in detail.

4.5.3.1 Phase 1 – Analysis of the e-learning tool

A review of the literature was undertaken to:

- Provide the researcher with up-to-date knowledge of how e-learning solutions are perceived and implemented in corporate contexts.
- Understand good practices in educational design and identify appropriate constructs that might assist with the analysis of the Apache Energy e-learning tool.

Detailed searches were conducted in electronic data-bases, on World Wide Web search engines, at e-learning conference sites, and through targeted Weblogs (Blogs). The literature review focussed on the application of e-learning to the resources sector to determine the extent to which an e-learning/e-training culture existed in this sector.

An analysis of the Apache Energy e-learning tool was then conducted according to an amalgamation of three constructs that describe effective learning. These were developed by Driscoll (2002), Oliver (2001) and Jonassen, Peck and Wilson (1999). The result was a comprehensive set of criteria with which to gauge the quality of the Apache Energy e-learning tool. These criteria embody the key aspects of the social constructivist theoretical framework in which the study is set.

The application of the criteria to this study is discussed more fully in Chapter 5, Findings: Design of the e-learning tool.

4.5.3.2 Phase 2 – Description of the implementation of the e-learning tool

Phase 2 of the research sought to attain an in-depth understanding of how the e-learning tool was implemented at the case study site. Data was harvested through the application of the techniques detailed in Table 4.4.

Table 4.4:
Data Collection Techniques

	Data collection technique	Rationale
1	Semi-structured questionnaire for contractors	Collection of data pertaining to initial perceptions of contractors' experiences with the e-learning process.
2	Semi-structured interviews with Apache Energy staff	Data on the aims and objectives of the e-learning tool and its implementation and initial perceptions on the effectiveness of the implementation.
3	Semi-structured interview with e-learning centre administrator	Data on the role and functions of the e-learning centre and initial perceptions on the effectiveness of the implementation.
4	Semi-structured interviews with contractors	Data on contractors' perceptions of the e-learning experience and the learning to have taken place.
5	Observation sessions with contractor/e-learning centre staff	Data on how contractor/e-learning centre staff engaged with each other and how contractors engaged with the e-learning tool.
6	Collection of artefacts	Data to substantiate evidence of policies, procedures and practices.

Appendices A-E provide the instruments that were used for data collection. It was considered that all of the above data collection techniques could be combined to provide a rich description of the implementation from multiple perspectives.

The Contractor Questionnaire (Appendix A) captured quantitative data, and also encouraged qualitative responses. The purpose of the questionnaire was to attain an understanding of the extent to which contractors were satisfied with the key components of the e-learning tool, and to afford opportunities to provide feedback on their overall perceptions. Responses to the questionnaires could be quickly scanned to provide the researcher with ideas for asking follow-up questions during interviews which took place immediately after completion of the questionnaire.

The questionnaire was administered at each of the three data collection periods and all participants completed it. The questionnaire was also available (although not actively promoted) to all individuals that attended the e-learning centre between May and December 2005. Thirteen individuals, who were not interviewed or observed, completed the questionnaire. This means that 40 individuals completed the questionnaire out of a total pool of 256 representing a response rate of 16%.

The questionnaire contained 26 items, 6 of which were open-ended, and 20 that asked respondents to rate (by ticking) various aspects of the e-learning experience on a scale of: strongly disagree, disagree, neutral, agree and strongly agree. The 20 rateable items were grouped into the following four sections:

- Program;
- Support;
- Tests; and
- Autonomy and Enjoyment.

Twenty-seven contractors were interviewed immediately after they had interacted with the e-learning tool and completed the questionnaire. This helped to gauge immediate impressions of the learning experience, and also to attain an understanding of the perceived usefulness of the e-learning tool.

The interviews with contractors were conducted over three data collection periods in June, August and October 2005. Using Patton's (1990) semi-structured approach, the interviewing process attempted to attain an understanding of contractors' behaviours, experiences, opinions and values. Interviews were typically of 15-30 minutes in duration.

The style of interviewing was informal, starting with a list of issues to be addressed, and encouraging participants to raise other issues. This conversational style enhanced flexibility allowing for new questions to emerge whilst maintaining the overall

coherency of the interview. Interview questions were asked in an open-ended fashion in order to "minimize the imposition of predetermined responses when gathering data" (Patton, 1990, p. 295). In the course of some interviews, new questions emerged, some as a result of examining the responses to the questionnaire that had just been completed and which required further exploration.

Safety advisers and management at Apache Energy and the e-learning centre administrator were interviewed at the commencement of the data collection process. The focus of these interviews was on establishing an understanding of the way in which the e-learning tool was implemented.

With the consent of participants, interviews were video-taped. Out of 31 participants, only one declined to be videotaped, but offered to be audio-taped.

Observations (non-participant) of how learners interacted with the e-learning tool were conducted at each of the data gathering sessions. Where possible, and with participants' consent, these were video-taped. Notes from these observations were taken and transcribed to a journal.

Relevant artefacts (e.g. emails, handouts and flowcharts available at the e-learning centre) were collected as a way of generating evidence of implementation practices, and to assist in triangulation of research findings.

Data collection tools were tested for authenticity through a peer review process with a professional learning and development practitioner employed with the AFL Framework, and a senior training officer from Conoco-Phillips (a multi-national oil and gas company). Both reviewers were provided with a CD of the Apache Energy e-learning tool along with the following data collection instruments:

- questionnaire - contractors;
- interview questions - contractors;
- interview questions - safety advisers;

- interview questions - e-learning centre administrator; and
- interview questions - safety manager.

Table 4.5 provides the feedback received through the peer review process.

Table 4.5:
Feedback From Peer Reviewers of Data Collection Tools

Instrument	**Reviewer**	
	Conoco-Phillips	**AFL Framework**
Questionnaire	Try to avoid using terms like "the learning process" and "reflect on your learning". It is better to communicate with oil and gas operators through plain English and keep the "training speak" to a minimum.	Suggest use the word "program" rather than "tool" when referring to e-learning.
Interview - contractors	Keep the questions short and simple.	No feedback.
Interview - safety advisers	No feedback.	Ask a question on the ideal learning environment – this may give some clues on Apache Energy's overall learning philosophy.
Interview - e-learning centre administrator	No feedback.	No feedback.
Interview - safety manager	Ask a question on whether the Safety Manager thinks the program has made a difference to site safety.	Ask a question on the ideal learning environment – this may give some clues on Apache Energy's overall learning philosophy.

This feedback was useful and most of the suggestions were incorporated into the design of the data collection instruments. The researcher felt that it was too early in the implementation of the e-learning tool to gather data about whether the tool has made a difference to site safety. This may be an avenue for further longitudinal research that may consider qualitative data and numbers of accidents/incidents before and after the implementation of the tool.

4.5.3.3 Phase 3 – Explanation of the outcomes to emerge as a result of the implementation of the e-learning tool

Phase 3 of the research sought to enhance understanding of the outcomes that emerged as a result of engaging with the e-learning tool. The combined use of techniques 2, 4 and 5 detailed in Table 4.4 contributed to the development of this understanding.

Apache Energy provided data on the number of learners to pass various aspects of the assessments embedded in the e-learning tool. Thus, achievement of competence provided some measure of participant success. However, the study also attempted to gauge whether any other learning occurred as a result of engaging with the e-learning tool. This may be, for example, knowledge and understandings of computers and/or deeper knowledge and understandings in relation to workplace safety issues. Part of the interview process with contractors involved attempting to unpack the types of learning that took place.

Phase 3 of the research also sought to explore the relationship between implementation practices and the outcomes that emerged. The overall aim was to enhance understanding of how the e-learning tool and the implementation practices associated with it affected the learning to take place.

Phase 3 of the research began during data collection. As Merriam points out: "A rich and meaningful analysis of the data will not be possible if analysis is begun after all data is collected" (1998, p. 177). The exploration of relationships employed a constant comparative method (Lincoln & Guba, 1985) in order to draw out themes and explore relationships. This occurred both during and after data collection.

4.5.3.4 Data preparation and identification

Data preparation and identification (Reid, 1992) suggests that data analysis involves accurately capturing information (preparation) and building meaningful and discoverable chunks of information (identification) from the qualitative data. This is particularly important in case studies that employ multiple data collection methods as it helps to facilitate the emergence of themes.

A derivative of Merriam's (1988) analytical framework for the organisation and presentation of data within an interpretive framework was adopted. This involved using QSR N6, a qualitative data analysis software program, to build an overall structure to the data which assisted in the initial stages of analysis.

A hierarchy of categories and sub-categories was created to facilitate the emergence of themes that were explored further in data analysis. Coding categories (e.g. similar phrases, remarks and relationships between variables), informed by guidelines developed by Bogden and Biklen (1992), were then undertaken as a prelude to conducting an analysis of the data.

4.5.3.5 Data analysis

The researcher conducted, video/audio-taped, and transcribed all 31 interviews. On transcribing the interviews (and the qualitative aspects of the 40 completed questionnaires), the researcher entered this textual data into the QSR N6 software. During processes of data collection, data entry and data manipulation (creation of categories and then themes), the researcher employed a constant comparative method of data analysis (Lincoln & Guba, 1985).

As data was collected, entered and coded in N6 at the conclusion of each period of data collection, categories were created to help *describe* what had happened at the case study site. This facilitated a natural mechanism for further data entry and coding to be considered within the context of current categories. In this way, the ongoing development of categories was informed by the qualitative data that had already been considered.

This process ensured that data collected at the commencement of the study fed back into interview questioning, improving the overall quality of the data collected.

On the development of the themes from these categories, the researcher used peer de-briefing to help clarify thinking and add other perspectives – essentially contributing to *explaining* what had happened at the case study site.

Lincoln and Guba (1985, p. 308) describe peer debriefing as:

> The process of exposing oneself to a disinterested peer in a manner parallelling an analytic session and for the purpose of exploring aspects of the inquiry that might otherwise remain only implicit within the inquirer's mind.

Peer debriefing was used in three ways in the research. The first, an informal approach, was in the context of discussion with the researcher's supervisor who provided ongoing feedback during and after data collection. The second application of peer debriefing was at a specifically arranged analytic session with an impartial peer. After an initial analysis of the qualitative data and development of a concept map, a session was held to facilitate articulation of the themes identified in the concept map, further exploration of these themes and examination of their credibility. The third instance of peer debriefing took the shape of ongoing contact with the Safety Manager at Apache Energy to discuss issues associated with the implementation of the e-learning tool and identify areas for further improvement. These three forms of peer debriefing contributed to the development of a triangulated approach to data analysis.

4.5.3.6 Triangulation

Triangulation is the use of multiple research methods, data sources and/or researchers to enhance the validity of research findings (Mathison, 1988). The use of multiple data collection methods (questionnaire, interview, observation, analysis of competency outcomes, and collection of artefacts), coupled with a constant comparative method of analysis and peer debriefing, provides evidence of a triangulated approach.

Stake (1994, p. 107) sets the concept of triangulation in the context of the qualitative research tradition and, in particular, the desirability of this tradition to achieve acceptable levels of validity:

> In our search for accuracy and alternative explanations, we need discipline, we need protocols which do not depend on mere intuition and good intention to 'get it right'. In qualitative research, these protocols come under the name of triangulation.

Triangulation is an effective strategy to achieve construct validity. That is the establishment of "correct operational methods for the concepts being studied" (Yin, 1994, p. 36). The study did not attempt to satisfy issues of external or population validity (Borg & Gall, 1989) – the degree to which the sample is representative of the population from which the sample is drawn – because the research makes no explicit claims to be generalisable outside of the context in which it is set. The focus is on credibility (Lincoln & Guba, 1985; Merriam, 1998). The study adopted the following strategies for optimising credibility (Sturman, 1994):

- Procedures for data collecting were explained to participants.
- Data collected was displayed and ready for re-analysis.
- Biases were acknowledged.
- The relationship between assertion and evidence was clarified.
- Primary evidence was distinguished from secondary and description from interpretation.

4.5.4 Role of the researcher

The researcher attempted to build relationships with contractors, safety advisers, managers and administrators in order to gain a level of trust and informality. The researcher ensured that all participants were aware of the independence and impartiality of the research at the commencement of each interview and at the commencement of any observation session involving contractors. Assurances were made in respect to confidentiality of participants' responses to interview questions.

In building relationships of trust, and to gain an empathetic understanding, the researcher was sometimes called upon to assist contractors, particularly with the technical aspects of the e-learning software. The researcher attempted to minimise these instances by referring queries to the administrative/technical support function that was provided at the e-learning centre. The researcher was careful not to enter into any facilitative relationships with contractors in relation to matters of workplace

safety. It could be said, therefore, that the researcher had a semi-participatory role during data collection sessions, particularly during the first data collection phase in June 2005 where Apache Energy experienced some initial technical challenges to the implementation.

4.5.5 Limitations of the research

The research is set in the oil and gas industry. It is acknowledged that this level of specificity limits the extent to which inferences can be drawn and applied to other industries and education sectors.

The study was conducted by one researcher, and although this has benefits in terms of the consistency of data preparation and identification, it is acknowledged that it has the potential to limit interpretation.

4.5.6 Ethical considerations

In the collection of data, using techniques like observation and interviewing, it is likely that some information may be deemed sensitive to the participants. The issues involved in establishing and maintaining rapport with management and administrative staff and participants in a corporate learning setting are essentially ethical ones. Hollingsworth and Socket (1994) believe that good research relationships are collaborative, requiring mutual engagement with the research process on the part of the researcher and participants.

This study, as a pre-requisite, required a Statement of Informed Consent by all participants. This statement protects participants against the release of information that may cause personal harm. Anonymity of participants was assured as part of the Statement of Informed Consent.

Managers, safety advisers, administrative support staff and contractors were approached to obtain a fair, balanced and accurate assessment of e-learning implementation practices. The researcher sought reasonable access to documents, data and people. All requests for access to data were granted by Apache

Energy. Data has been securely stored, both in electronic and hard-copy formats, and will be available for a period of five years.

This chapter has attempted to describe the qualitative framework in which the study is situated and the interpretive approach and case study method adopted by the research. It has offered a description of the research design, approach and methods used to collect and analyse data. Finally, it has considered the role of the researcher, the limitations of the research and the ethical conduct of the study.

Chapters 5-7 now present the findings of the research.

CHAPTER 5
Findings:
Design of the e-learning tool

5.1 Chapter overview

This chapter presents the findings that emerged from Phase 1 of the study. This phase was primarily concerned with exploring research question 1:

What design principles underpin an e-learning tool developed for an oil and gas organisation in the area of workplace safety?

The chapter builds upon the literature on effective e-learning design principles that was identified in Chapter 2, particularly focussing on the work of Driscoll (2002), Oliver and the AFL Framework (2001), and Jonassen et al.(1999) to generate an understanding of how constructivist learning theory relates to the Apache Energy e-learning tool.

The chapter then combines the critical elements of the frameworks for effective learning developed by the above authors in order to provide a comprehensive basis for a description of the design principles that underpin the Apache Energy e-learning tool.

Finally, as a mechanism to check the integrity of the analysis of the e-learning tool, the chapter considers contractors' perceptions of the tool. A brief summary of the findings from Phase 1 of the research is presented at the conclusion of the chapter.

5.2 Effective e-learning design: What the literature says

The literature review undertaken to inform this study suggests that there is agreement amongst contemporary scholars that constructivist approaches to the use of ICTs for

learning create the most effective outcomes for students, teachers, employees and employers (Eklund & Kay, 2003; Herrington, Oliver, & Reeves, 2003; Hobbs, 2002; Oliver, 2001).

Driscoll (2002) crystalises the features of constructivism into four basic principles:

- Learning occurs in context.
- Learning is active.
- Learning is social.
- Learning is reflective.

A contextual basis for learning occurs when the learning is set within the "real world". Real world contexts can emerge when learners make linkages between functional requirements of everyday life and the knowledge gained from a potential learning experience. If learning is meaningful to a current or future work task, for example, then there is a greater likelihood that it will be integrated into existing understandings. According to Driscoll (2002), one of the great challenges of technology is to assist in the process of contextualising learning by providing real world contexts that engage learners in complex problem solving.

Providing learners with opportunities to become mentally involved in their learning, "generating connections between what they already know and what they are being asked to learn" is what Driscoll (2002, p. 3) means by active learning. Using tools to "think with", rather than as a mechanism to mediate aspects of the curriculum, helps learners to develop ideas and identify with the process itself. Examples of tools that facilitate thinking could be brainstorming and concept mapping tools or tools that help express data in different ways (e.g. spreadsheets).

Driscoll's (2002) third principle of constructivism is the social basis for learning. This is more than just communication between people to enhance their individual understandings. Learning becomes more meaningful when it moves from the realm of demonstrating competence to increasing participation and contribution to a social

community. The adoption of dialogue-based e-learning strategies (e.g. discussion boards) to build relationships within groups is one way to enhance the social basis for learning.

Finally, Driscoll (2002) stresses the importance of reflection in learning. This can be stimulated when learners access feedback about their thinking. Reflection can be part of a broader dialogue, and as such, is undertaken within the context of social interactions with peers and/or teachers/trainers.

Jonassen et al. (1999) subscribe to the view that the primary goal of education (at all levels) is to provide opportunities for people to engage in meaning making. According to the authors, meaning making occurs when learners engage in active, constructive, intentional, authentic, and cooperative learning. These categories, which are interdependent, resonate with Driscoll's (2002) four principles (see Table 5.1).

Jonassen et al. (1999) argue that the use of computers as tools to transmit or broadcast information (i.e. as substitute teachers) will not lead to any great success in facilitating genuine meaning making that is readily transferable to other contexts. The authors suggest that a fresh approach to conceiving computers in learning may be to consider them as "mindtools" (cognitive tools). This involves a shift in thinking from using computers in a passive and transmissive fashion towards seeing computers as part of a partnership – a point also made by Driscoll (2002). In these circumstances, learners manipulate the learning space (e.g. by building and testing scenarios using a spreadsheet) and observe the results of their input.

Driscoll's (2002) reflective principle equates with Jonassen et al's constructive (articulative/reflective) category (1999, p. 9) where both descriptions acknowledge that integrating new experiences with prior knowledge and reflecting upon this process helps to build new mental models and create new meanings.

Driscoll's (2002) "learning occurs in context" principle and Jonassen et al's (1999) authentic (complex/contextual) category both suggest that learning activities that are

situated in a real world context will be better understood and transferred to other situations.

Finally, there is a congruency between Driscoll's (2002) social principle and Jonassen et al.'s cooperative (collaborative/conversational) category (1999, p. 10) where both authors conceive learning as a natural social act, rather than an activity that is individually owned and then assessed.

Jonassen et al. identify one other category – intentional (reflective/regulatory) – which acknowledges that all learning is goal oriented and that affording learners the opportunity to articulate their goals is "essential for meaningful learning" (1999, p. 9). This intentional aspect of learning promotes learner control of the learning process and also a metacognitive orientation.

In 1999, the AFL Framework embarked upon an endeavour to develop e-learning content for the VET sector. To inform developers of e-learning products, a set of principles were developed that were said to promote effective teaching and learning approaches. These principles provided a framework for developers to build resources with the following features:

i. an educational model which recognises an active, constructive role for learners;

ii. learning activities which engage the learner in active processing of the subject matter rather than mere knowledge acquisition;

iii. learning settings and tasks that encourage meaningful online communication and interaction (between learners as well as between teachers and learners);

iv. content resources which are visually attractive, motivating to use and organised logically for ease of navigation;

v. representations of authentic and real life settings in preference to textual descriptions.

(Oliver, 2001, p. 206)

There are many similarities between these features and those previously identified by Driscoll (2002) and Jonassen et al.'s (1999). However, there is one notable addition. The AFL Framework is explicit in its desire to develop visually attractive, motivating and logically organised learning resources (iv. above). This was also important for Apache Energy as it was predicted that many of the contractors that engaged with the e-learning tool would not be familiar with computers or e-learning.

Table 5.1 shows the relationships between Driscoll's (2002), Jonassen et al's (1999) and Oliver/AFL Framework's (2001) conceptions of designs that underpin effective learning.

Table 5.1:
Driscoll's (2002) Principles of Constructivism, Jonassen et al.'s (1999) Attributes of Meaningful Learning and Oliver/AFL Framework's (2001) design features

Category - Learning is…	**Driscoll's principles**	**Jonassen, Peck and Wilson's Attributes**	**Oliver/AFL Framework's design features**
Authentic	Learning occurs in context	Authentic (complex/contextual)	Representations of authentic and real life settings
Active	Learning is active	Active (manipulative/observant)	Learning activities which engage the learner in active processing of the subject matter
Collaborative	Learning is social	Cooperative (collaborative/ conversational)	Learning settings and tasks that encourage meaningful online communication and interaction
Reflective	Learning is reflective	Constructive (articulative/reflective)	An educational model which recognises an active, constructive role for learners
Metacognitive		Intentional (reflective/regulatory)	
Visually motivating			Content resources are visually attractive, motivating to use and organised logically for ease of navigation

5.3 Application of principles of effective learning to the Apache Energy e-learning tool

In reviewing these works, it was discovered that there was overlap in criteria the authors felt were indicative of effective learning in computer-based environments. As such, rather than choosing one framework over another, all three were merged to generate a comprehensive schema against which the design features of the Apache Energy e-learning tool could be closely examined. Table 5.2 provides a description of each aspect of the schema in addition to a narrative on how the Apache Energy e-learning tool responds to each aspect.

Table 5.2:
Schema for Effective Learning

Criteria – Learning is…	Description	Apache Energy e-learning tool
Authentic	Learning has a real life and useful context	The Apache Energy e-learning tool exhibits a high level of authenticity. Content, tasks and assessment are all set in real life contexts, and are integrally related to safety practices that are required to be adhered to when contractors attend an Apache Energy facility.
Active	Learners observe manipulate objects in their environment and construct their own interpretations as a result of these actions	Contractors are afforded some opportunities to engage in scenarios and to think about and interpret these through quizzes, real world examples and assessment items. However, there are limited opportunities to create and/or manipulate objects other than in scenarios where the software generates feedback in response to performed actions. The software is not designed as a cognitive tool where contractors make choices about when and how to use it. A more appropriate description might be a set of micro-worlds where contractors interact with realistic scenarios that mirror a real world oil and gas facility.
Collaborative	Learners are afforded opportunities to converse and collaborate	The tool is designed for independent learning, and there are limited opportunities for conversation and collaboration at the e-learning centre. Some contractors may spontaneously converse with one another at the e-learning centre, but this is not encouraged. Once contractors arrive at the oil and gas facility, safety advisers use the results obtained from the testing components of the tool in a diagnostic way and this is achieved in via direct face-to-face communication.
Reflective	Learners reflect on activities and observation and learn from this	The design of the tool was conceived in a way in which contractors would be encouraged to reflect upon their current knowledge-base and select activities and content based upon an appraisal of their current understandings. There is scope for self-reflection whilst users are engaging with the tool, and the tests embedded in the tool certainly encourage this. It is also possible that contractors reflect on the tool after they leave the e-learning centre, and learning will become more meaningful once they arrive at the oil and gas facility, receive a workplace induction from their supervisor and commence work.
Metacognitive	Learners articulate their goals	The design of the e-learning tool provides no opportunities for contractors to articulate their goals. There is an expectation from Apache Energy that the safety concerns inherent in the tool will also be important to contractors.
Visually motivating	Resources are visually attractive, motivating to use and organised logically	Learning resources are designed to be cognisant of variable literacy levels. Graphical and textual representations are provided, typically in an integrated way. A range of media is used including text, audio, video and (where appropriate) a mix of all of these. Navigation attempts to satisfy a “step-by-step” approach for those inexperienced in working in an oil and gas environment and a “self-select” approach for those with prior competency.

In conducting this analysis, it was evident that the Apache Energy e-learning tool:

Satisfied two criteria:

- Learning is authentic.
- Learning resources are visually motivating.

Did not satisfy two criteria:

- Learning is metacognitive.
- Learning is collaborative.

Satisfied two criteria to a certain extent:

- Learning is active.
- Learning is reflective.

These findings are now elaborated upon below.

5.3.1 Criteria for effective learning that are satisfied

The Apache Energy e-learning tool satisfies the *authentic* criterion. The tool attempts to provide realistic scenarios (some of which use events and/or Apache Energy policies and procedures) that engage contractors in worthwhile and interesting tasks, and ensure that comprehensive feedback is given to consolidate learning. Assessment is grounded in Apache Energy's permit to work processes and related safety issues that have been identified in the past.

The design of the e-learning tool was accomplished such that learning resources were *visually motivating*. There was an acknowledgement that contractors would engage with the e-learning tool independently, and that the resources contained within the tool needed to be engaging and logically structured. A broad range of media formats were used including text, audio, video, slide shows that incorporate audio and static graphics, and interactive animations. It was anticipated that the combination of these

media formats would provide a motivating learning environment. The navigational structure provided two options:

- A non-linear option for contractors who were experienced in working in oil and gas environments and were able to assume control of their own learning to the extent that they could identify and respond to knowledge gaps.
- A linear option where contractors who were not used to using computers could work their way through the activities and resources in a logical and consistent manner.

Given that these options are appropriately presented to contractors, it is anticipated that they will promote a level of learner choice in how they interact with the e-learning tool.

5.3.2 Criteria for effective learning that are not satisfied

The *metacognitive* criterion is not met. There are no opportunities to state learning goals and there is no negotiation on the requirements of Apache Energy in terms of the outcomes expected. It may be that this criterion is more relevant to a formal education context rather than a corporate learning environment.

Similarly, the e-learning tool did not comply with the requirements of the *collaborative* criterion. There is no collaboration or cooperative activity expected between contractors, and only limited facilitation provided at the point of engaging with the e-learning tool. There is an acknowledgement, however, that contractors may engage in conversations outside of the e-learning centre (both on- and off-site), and when contractors attend site, one-to-one opportunities are provided with the safety adviser for contractors that exhibited perceived gaps in safety understandings.

5.3.3 Criteria for effective learning that are satisfied to a certain extent

The *reflective* criterion of the tool is difficult to measure. On being introduced to the e-learning tool, the design assumes that contractors will be encouraged to self-reflect

on their current safety understandings, and choose a learning pathway that is appropriate to them. Further, as contractors engage with the tool, feedback is configured to promote reflection and contractors can make navigation choices at anytime to explore in greater depth, to re-visit or to take an assessment. Finally, one of the duties of the safety adviser is to ensure that all contractors have an understanding of basic safety issues in an oil and gas environment, and targeted questioning techniques are employed on-site to promote reflection.

The *active* attributes of the Apache Energy e-learning tool are also satisfied to a certain extent. It is pertinent at this point to highlight the important distinction between learning *from* computers and learning *with* computers (Jonassen et al., 1999; Reeves, 1999b). The Apache Energy e-learning tool is an example of learning *from* computers, where the software is designed to stimulate information acquisition, and where possible, knowledge construction. However, there are no opportunities for contractors to engage in higher order learning activities like solving ill-defined problems or concept mapping. The tool is focused on introductory and uncomplicated understandings of safety issues.

The software is not designed, therefore, for what Jonassen et al. (1999) might describe as a mindtool or cognitive tool where contractors make choices about when and how to use it, extending their creative and manipulative abilities. A more appropriate description of the tool is a set of micro-worlds where contractors interact with realistic scenarios that mirror a real world oil and gas facility. The software does not ask or require contractors to create or manipulate objects, and the reason for this is that, other than the on-site safety adviser, there is no human support provided with the tool (i.e. no teacher or trainer to challenge or extend the learning of contractors).

The decision to put boundaries around the creative and manipulative dimension of the e-learning tool was deliberate, based upon the realities of workplace learning, but also an appraisal of the learning requirements of contractors.

Jonassen and Tessmer (1996) provide a taxonomy of learning outcomes that shows the linkages between classifications of type of knowledge and instructional strategies that can facilitate learning. It identifies a range of outcomes from declarative

(e.g. recognition and recall) through to higher order cognitive, metacognitive and motivational learning outcomes. The taxonomy offers a holistic perspective and encourages exploration into the relationship between instructional strategies and learning outcomes at a number of levels.

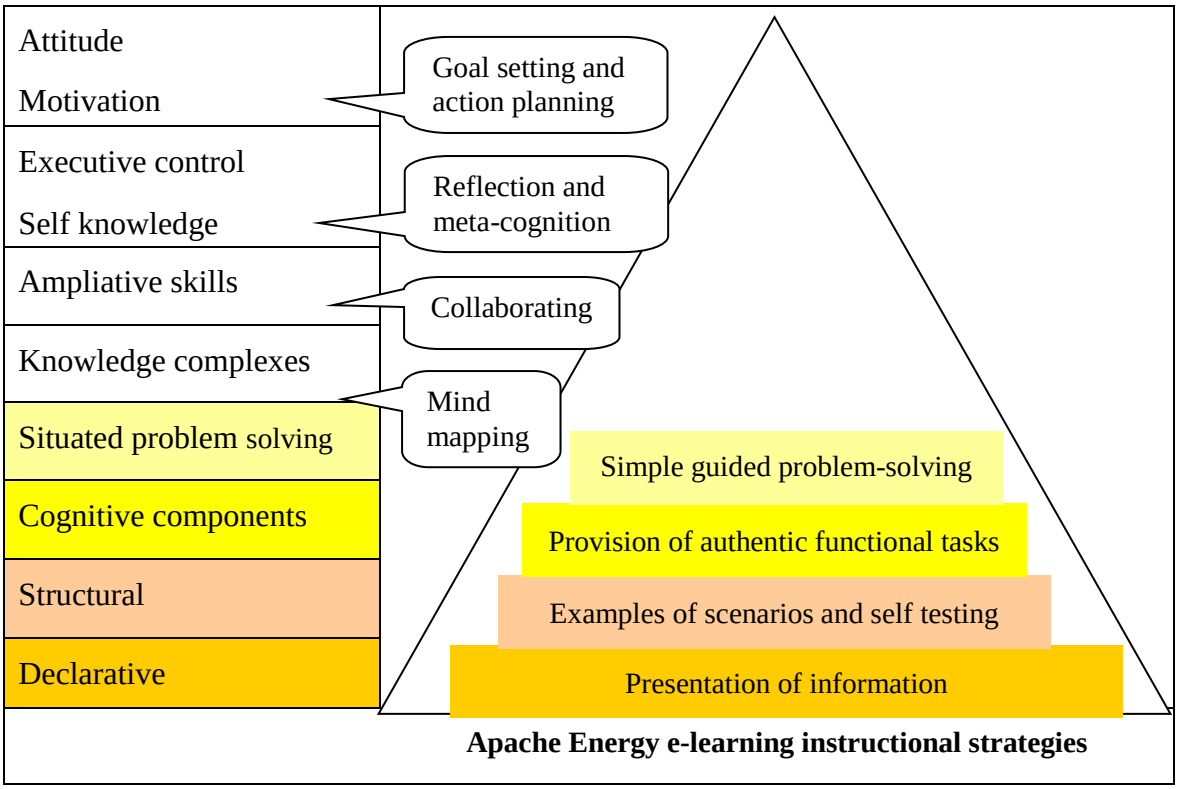


Figure 5.1: **Apache Energy e-learning tool in relation to Jonassen and Tessmer's (1996) knowledge classifications.**

Figure 5.1 shows that the types of instructional strategies embedded in the Apache Energy e-learning tool are appropriately oriented towards Jonassen and Tessmer's (1996) first four knowledge classifications.

Instructional strategies that promote higher order learning (e.g. Ampliative skills which are about generating new interpretations, constructing/applying arguments, analogising and debating; or Self knowledge which is about articulating prior knowledge, prejudices, weaknesses) are not aligned to Apache Energy's learning goals for the e-learning tool, and are therefore not promoted.

The implications for targeting the design of the Apache Energy e-learning tool at Jonassen and Tessmer's (1996) first four knowledge classifications are that two

aspects of the schema for effective learning outlined in Table 5.2 – metacognitive and collaborative learning – are not met: Goal setting and Ampliative skills are higher order knowledge classifications that call for a greater level of facilitator input. This was an aspect of the educational model to which Apache Energy was not prepared to commit for both financial reasons, but also based upon an appraisal of its learning requirements for on-site safety.

5.4 Verification of analysis of the e-learning tool with contractors' perceptions

Many of the observations made from this analysis of the Apache Energy e-learning tool are supported by the findings to emerge from the data. Each criteria identified in Table 5.2 is now addressed in relation to data collected through the Contractor Questionnaire and interviewing of contractors.

The Contractor Questionnaire asked participants to rate various aspects of the tool on a scale of 1-5 (1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree). Mean scores are displayed in graphical form in Figures 5.2-5.4 along with standard deviations (in brackets).

5.4.1 Learning is authentic

Three items in the Contractor Questionnaire related to the authenticity of the e-learning tool. These were:

- I found the real world examples valuable.
- I think what I learnt will be useful in the oil and gas industry.
- The activities in the e-learning program relate to the real world.

The above items are displayed in Figure 5.2.

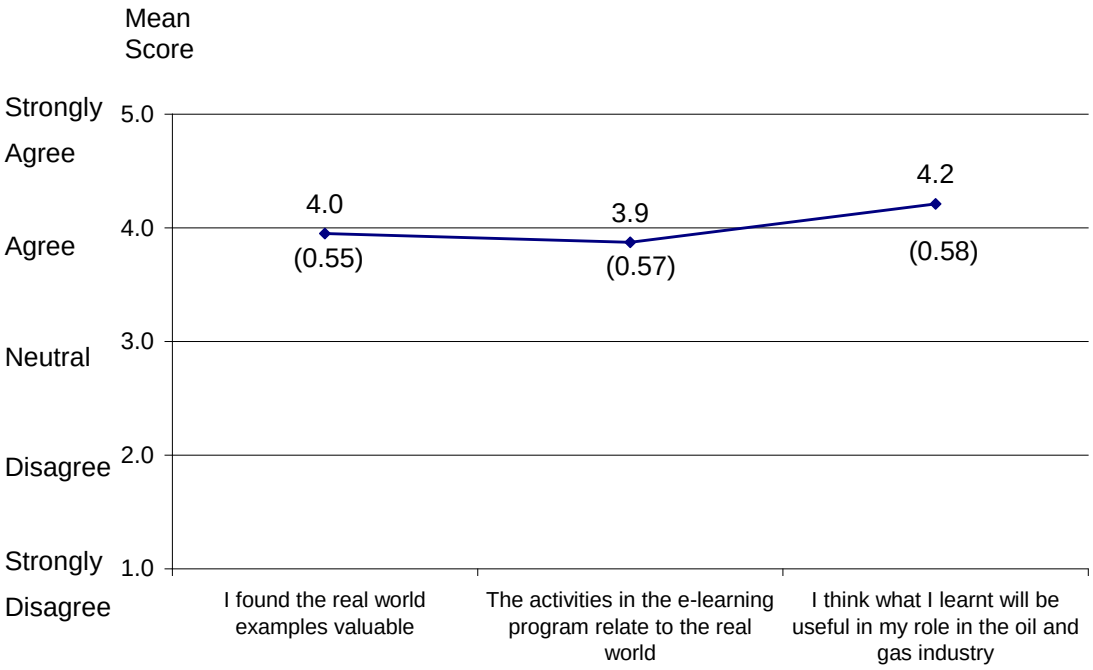


Figure 5.2. **Apache Energy e-learning tool questionnaire results: Mean scores and standard deviations on items relating to authenticity.**

Results indicate that respondents tended to regard the e-learning tool as authentic and useful. This was in keeping with the findings from the analysis of the e-learning tool which suggested that the tool complied with the authenticity criterion. Qualitative data also corroborates that the authentic attributes of the tool were appreciated by contractors:

> The pictures and the captions and the real life footage of the site you were going to was pretty good. It's not just a cartoon, what you see is what you are going to go to. I thought that was pretty good.
>
> I23a:10-13

> Yes, I reckon it's pretty good. You get everything, pictures of the place, little documentaries and stuff. It's pretty good, very good – covers everything.
>
> I1:70-72

5.4.2 Learning is visually motivating

Two items in the Contractor Questionnaire dealt with the navigational and visually motivating aspects of the e-learning tool. These were:

- The program was easy to navigate.
- The use of audio and visual material was engaging.

These items are displayed in Figure 5.3.

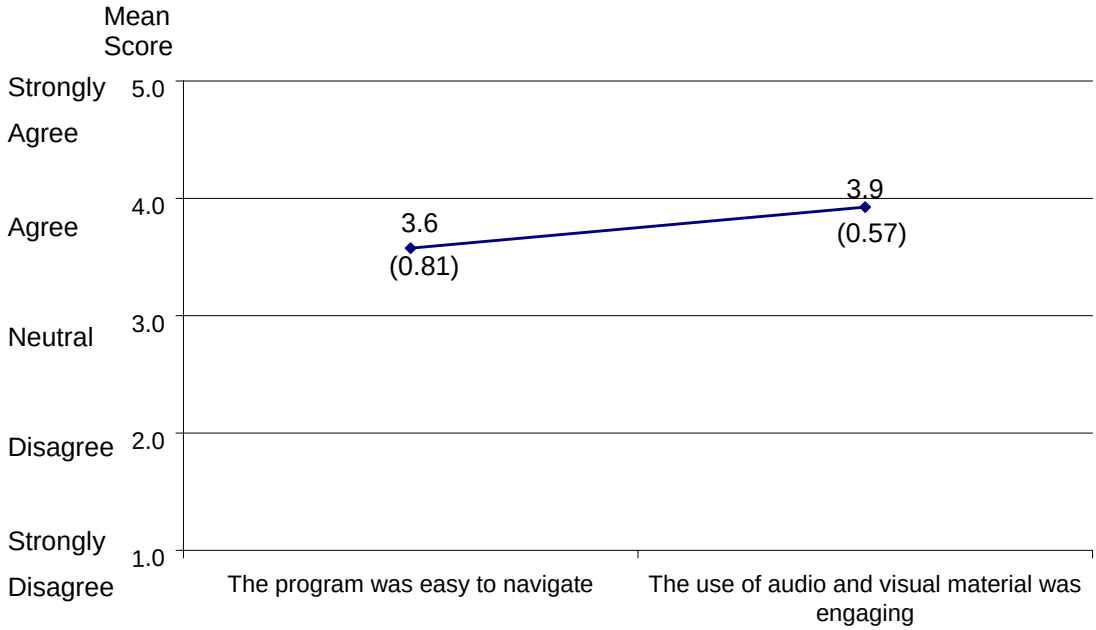


Figure 5.3. **Apache Energy e-learning tool questionnaire results: Mean scores and standard deviations on items relating to navigation and use of audio and visual material.**

The visually motivating attributes of the tool were generally supported by contractors, who tended to agree with the statement that "The use of audio and visual material was engaging". The qualitative evidence supports the findings from the analysis of the e-learning tool on the visually motivating criteria. It was interesting that many contractors also found the audio material to be engaging:

> I found the way it was put together excellent, and just the changes in different medium, you know whether it was sight or sound, makes it interesting.
>
> I131:33-37

> It broke it up a bit, you could sit back and listen a bit and what not, and it was more interactive I think.
>
> I151:42-43

> With that [the e-learning tool] the notes are already there, it's multiple choice and you can go back and forward and in and out of things and actually hear narratives that talk to you and tell you to press play and watch like little short movies of something and that's very good technology. I like that.
>
> I3:77-81

However, Figure 5.3 also reveals that contractors exhibited slightly lower levels of satisfaction in relation to the navigational aspects of the tool. Qualitative feedback acquired through the Contractor Questionnaire and interviews suggests that there were variable attitudes towards the navigation. On the negative side:

> Here you have too many choices. I thought especially if you were unfamiliar with computers, there were just too many options. You could do the quiz or take the test or Real Life or click the next button. I thought it wasn't straight forward enough, you know go from learn this, go to the next page and then do the test. I just thought it was too hard to navigate.
>
> I181:84-89

> I think I mentioned the only thing that I found was that there's a lot of choices in routes how you can get to the same position, and I started to find that I wasn't entirely sure of what I've covered. Whereas if it is chronological, and I'm not saying that you should do that because I thought it was great that you had the facility to miss bits that you didn't need. But I did find that a little confusing but that's probably just me.
>
> I8:148-154

> It was good. I think it works well. Probably some of the navigation principles could be a bit clearer. At times to go for the "next button" instead of, being unsure on whether I'd missed an area. You've got your active areas on an object to take you to the different sections. Having gone through one area, and then hitting the next button, I wasn't sure if I'd missed another area by hitting the next button.
>
> I9:51-56

On a more positive note:

> Most inductions I've ever done they have always had a lecturer standing up, that's the first I've done on a computer and I thought it was very easy, step-by-step, very easy to follow, yes.
>
> I3:48-50

These varying sentiments are not entirely consistent with the findings from the analysis of the e-learning tool where the tool was gauged to have complied with the visually attractive criterion which required resources to be organised logically. This point of fracture between design and implementation is revealing. The navigation

was designed to cater for contractors that may have variable levels of competence across a range of safety issues. For example, an experienced contractor that had worked under permit systems in the oil and gas industry, but had no knowledge of confined space environments, could go straight to the tests after dealing with the confined space component of the e-learning tool. Conversely, an inexperienced contractor who has never worked in an oil and gas environment may choose to work through the entire tool methodically. This level of flexibility meant that the "start" and "finish" were sometimes difficult to discern.

The results from the Contractor Questionnaire and interviewing suggest that some respondents may have been unaccustomed to, and confused by, the e-learning design. This may have been related to the tendency of the administrator of the e-learning centre to introduce the navigational aspects of the tool in a way that was contrary to the design:

> Don't use these navigation buttons because they will take you to different areas and you will lose completely where you are.
> *(Administrator uses the mouse to point to the top navigation buttons.)*
>
> o_m:6-9

A thorough introduction to the thinking behind the e-learning tool, rather than just how to interact with the tool, may have alleviated the levels of confusion that some contractors exhibited.

5.4.3 Learning is reflective

The analysis of the design of the e-learning tool advocates that the reflective criterion for effective learning is met to a certain extent. This conclusion is based upon an assumption that at least three opportunities would be afforded to contractors before, during and after the e-learning experience, that may stimulate reflection of their current knowledge-base in the context of the information that is available in the tool:

i. The navigational design of the tool encourages contractors to reflect upon their current knowledge-base and select activities and content based upon an appraisal of their current understandings.

ii. Reflection is implicitly encouraged whilst users are engaging with the tool, particularly when considering the feedback provided in the quizzes.

iii. Contractors may reflect on the e-learning tool once they arrive at the oil and gas facility, receive a workplace induction from their supervisor and commence work.

As discussed, the self-select navigational aspects of the tool (i. above) were not introduced in the e-learning centre, so design attributes of the e-learning tool that were thought to be in tune with principles of effective learning, were not followed through in the implementation.

Similarly some aspects of the e-learning tool like the quizzes (ii. above), which were designed to provide scope for reflection through detailed feedback, were not seen as an important component of the design by the administrator of the e-learning centre:

> They are only quizzes, they are not the actual test. If you get stuck on it, there's no need to get worked up about it. Work through as much as you can, but it's not the actual test.
>
> o_m:12-15

Notwithstanding the way in which some components of the tool were introduced, there is evidence in the qualitative data that contractors did reflect on the information embedded in the e-learning tool in the context of their own knowledge-base. For example, the following excerpt is from a contractor that critically appraised the content available in the tool:

> Perhaps the only area that requires a little more insight is the area of personal protection gear for site. Obviously it does cover the basic safety requirements, but then I've heard mention of the requirement for reflective tape on work clothes and that wasn't mentioned.
>
> I9:27-31

The study was conducted over a relatively short timeframe and no data was collected to provide evidence of reflection once contractors had left the e-learning centre.

5.4.4 Learning is active

The analysis of the design of the e-learning tool suggests that the active criterion for effective learning is also met to a certain extent. The qualitative data supports this assertion. Although the e-learning tool is clearly not a cognitive tool as Jonassen et al. (1999) define this term, there was a sense that contractors were compelled to engage with the tool and this implies some level of active manipulation of the environment:

> I think it keeps you more alert. When you've got a lecturer I guess you sort of sometimes wander away and look out the window, but with that you've got the earphones on, you've got the computer and it's a lot more hands-on. It's you and the computer. It's more of like a one-on one sort of thing than a lecturer with a group of people. So your attention is very much focused on the software. I thought it was really good.
>
> I3:64-69

> This one was yes definitely [good] because you've got to really do the quizzes and do the answers. It forces you to do it, whereas a lot of times a guy stands in front and talks to you for an hour and you fall asleep.
>
> I8b:43-46

> I think its better [the e-learning process]. Face-to-face inductions are usually limited to half a day of someone sort of presenting. This is more intense, for a shorter period… I think it probably forces you to take a bit more notice of the detail.
>
> I9:38-41

5.4.5 Learning is collaborative

The quantitative data suggests that collaboration between contractors did not feature strongly in the implementation of the e-learning tool. Again, this is consistent with the conclusions reached from the analysis of the e-learning tool. Figure 5.4 shows that, whilst most contractors were satisfied with the human resource support components provided for the e-learning tool (e.g. introduction, response to enquiries), there was very little collaboration between contractors during the learning process.

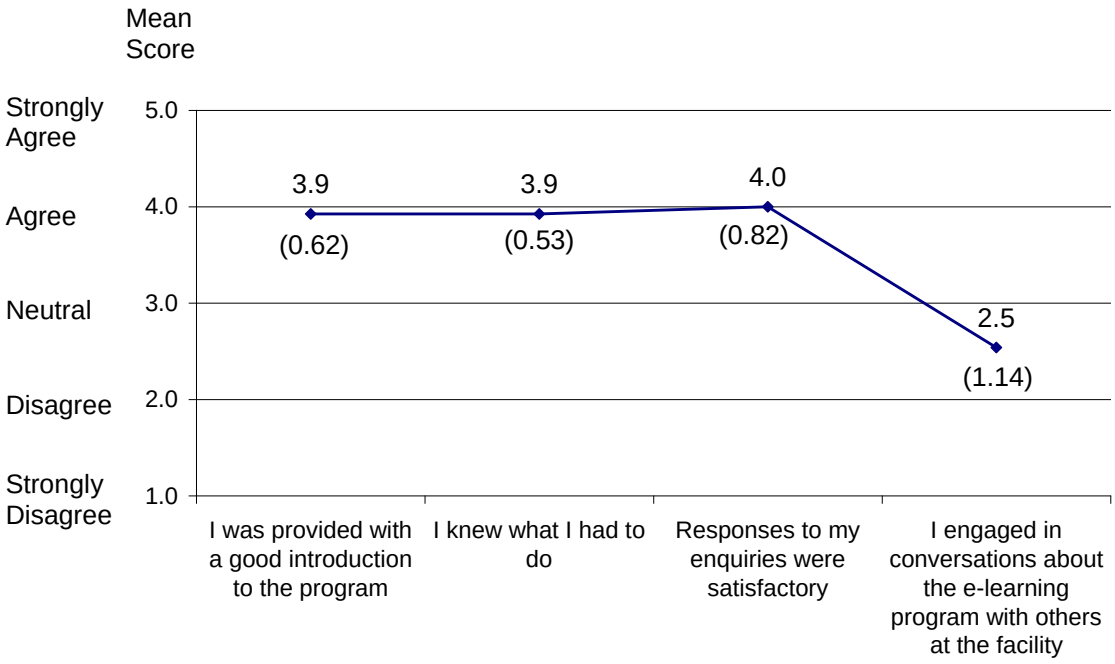


Figure 5.4. **Apache Energy e-learning tool questionnaire results: Mean scores and standard deviations on items in relation to human support.**

When questioned during interviewing about the lack of opportunities for social interaction, most contractors seemed unconcerned:

> Interviewer: Did you find yourself yearning to communicate with someone or were you happy to interact with the computer?
>
> Contractor: I was happy to interact with the computer.
>
> I9:43-46

> Contractor: It was good because you can concentrate without four or five different students in the class answering questions for you. You're doing it yourself, you know.
>
> Interviewer: So when you look at this in relation to the traditional way of inducting people like a workshop or classroom type situation, do you prefer the e-learning or the face to face way of doing it?
>
> Contractor: Face to face is good but this one is better because you can go back and listen to what they're saying [using the audio components of the tool] instead of asking the teacher. You get that and kind of holding up the class.
>
> I11:34-46

5.4.6 Learning is metacognitive

The analysis of the e-learning tool proposed that the metacognitive criterion for effective learning was not met. There was an expectation that the safety concerns that Apache Energy held to be important, and that were implicit in the design of the e-learning tool, were also important to contractors. Since the design of the e-learning tool provided no opportunities for contractors to articulate their own goals, no data was collected on the metacognitive attributes of the tool.

5.5 Summary

Overall, contractors exhibited positive attitudes towards the design of the tool particularly supporting its authentic and visually motivating attributes. The analysis of the design of the tool in the context of the data collected reveals some points of fracture between design and implementation, mainly in relation to navigation and opportunities for reflection. These are unpacked in Chapter 6, Findings: Implementation of the e-learning tool.

This chapter has provided the results of Phase 1 of the research. It has shown that, overall, the e-learning tool has some of the crucial attributes for effective learning. Learning resources are visually motivating and learning opportunities are mediated in authentic ways. However, the analysis of the tool suggests that metacognitive and collaborative criteria were not seen as imperative in this corporate learning context. The reflective criterion was included as part of the overall design of the tool, but its effectiveness was contingent upon this feature being promoted and facilitated. Finally, the active attributes of the tool were used selectively in response to the limited support that was anticipated by Apache Energy and the perceived learning requirements of contractors. In Jonassen and Tessmer's (1996) knowledge classification taxonomy, declarative and structural instructional strategies were augmented by some authentic functional task setting and situated problem solving.

Contractors seemed to respond well to the e-learning tool, appreciating its attributes of authenticity and the range of media options available. Apart from the navigation,

which some contractors found confusing, no major issues were raised in relation to the design of the tool.

The extent to which the design – as described above – impacted on the overall quality of the implementation and the learning outcomes that emerged is discussed in Chapter 8, Discussion and Conclusion.

CHAPTER 6
Findings:
Implementation of the e-learning tool

6.1 Chapter overview

This chapter presents the findings that emerged from Phase 2 of the study (description of the implementation of the e-learning tool) which deals with research question 2:

How has this e-learning tool been implemented in an oil and gas organisation?

The chapter first examines how contractors interacted with the e-leaning tool (sub-research question 2.1: How did contractors interact with the e-learning tool?). The following five categories are proposed to capture the essence of Apache Energy's learning model, and are used to describe the implementation:

- Contractors' objectives and motivations.
- Contractors' computer skills.
- The e-learning process.
- The relationship between social resources and the e-learning tool.
- Assessment of competency.

The chapter then presents a description of the implementation through two detailed observations that were conducted as part of the research. The first observation is with a young contractor who is inexperienced in working in an oil and gas setting, but competent with using computers; the second observation is with an older contractor who is experienced in working in the oil and gas industry, but who has limited competence with using computers.

Finally, the chapter looks at the extent to which the implementation of the e-learning tool complemented its design (sub-research question 2.2: To what extent did the implementation complement the design of the e-learning tool?). A consideration of how the e-learning tool was implemented from the perspectives of e-learning centre support staff and safety advisers is undertaken to respond to this sub-research question.

A brief summary of the findings from Phase 2 of the research is presented at the conclusion of the chapter.

6.2 Description of the implementation

6.2.1 Contractors' objectives and motivations

The Contractor Questionnaire was concerned with contractors' perceptions of the e-learning experience and did not address contractors' underlying learning objectives and motivations. However, during interviewing, the researcher was able to build a picture of why contractors engaged with the e-learning tool and how motivated they were. One of the questions asked relatively early in the interview was "What was your main objective in using the Apache e-learning program?".

Given that most contractors were engaging with the tool because they were told that it was a mandatory requirement for attending the Apache Energy oil and gas facility, the question drew predictable responses along the lines of:

> I've been asked to go away offshore on Varanus Island and it's required to do that.
>
> I1:5-6

> Every job you go to, you've got to do an induction. Whatever job you're working on. So I was doing one in Perth before I get to do one up there I suppose.
>
> I11:19-21

> To work offshore. It was a requirement.
>
> I2:5-10

For a number of those interviewed, the core objective of engaging with the e-learning tool was closely aligned to passing the tests:

> To do it competently, and get past all of the tests really.
>
> I10:16-17

> I needed to pass to get there.
>
> I14:36-38

When pressed further about their objectives, though, most respondents exhibited a genuine interest in site safety, and a desire to increase their knowledge about the particular safety issues that were pertinent to Apache Energy:

> I've done many inductions in the oil and gas industry so there is a lot of interest.
>
> I4:55-56

> Why are we doing it? For knowledge about where we are going to be working, and what's involved and what's happening out there. Well I'm going to the Island, and I want to make sure that I'm all safe and everything is done properly.
>
> I7:6-10

> It's important. I don't want to get on site and not be able to fill out a permit. I mean I have done them before, but every site you go to they've got different kinds of permits, and they all vary.
>
> I11:85-88

For some contractors new to the oil and gas industry, the primary objective was not to make any mistakes that may cause them to be responsible for unsafe conditions which would affect others:

> I think of myself as pretty good on safety. I've been in the industry a while now and if I do miss something or get something wrong, that's a bit of a strike against myself really. You're out there - one mistake and you could kill thousands. It's not like I can say, "I stuffed up". Safety is the most important thing.
>
> I23a:25-31

> You've got to go out there knowing what you're doing and stuff otherwise it's not going to be a safe environment for others.
>
> I1:61-62

> I'm more confident with the processes to make sure you don't get into the bad books on site.
>
> I21:8-9

Contractors generally exhibited high levels of motivation to learn something from the experience. Biggs and Moore (1993) attribute high levels of motivation to two factors:

- the extent to which the activity is valued; and
- the extent to which a learner expects success.

Most contractors that were interviewed valued the safety ethic. It was "functionally important" in their immediate lives (Biggs & Moore, 1993, p.257). However, expectations for success varied, and it was mainly contractors with limited computer skills that tended to be least motivated, possibly because they felt that this prejudiced their chances of success:

> I've been to heaps of inductions, you know, going from Alcoa inductions to BHP inductions and Western Mining and all sorts, and you're always communicating with whoever is doing the induction. And I find that that can probably be an easier method rather than clicking here and clicking there and wondering where you went wrong.
>
> I7:38-41

Notwithstanding comments like this, the combined effect of perceptions that engaging with the e-learning tool was mandatory, that passing the tests was a requirement, and that site safety was important, meant that most contractors were highly motivated and eager to learn. Even those with limited computer skills tended to approach the tool with some level of enthusiasm.

6.2.2 Contractors' computer skills

Most contractors who completed the questionnaire had access to a computer and the Internet at home (see Table 6.1). However, this should not be taken as indicative as any measure of computer and/or Internet literacy. During interviewing, it was identified that some contractors perceived themselves as "computer illiterate" admitting that, although they had access to a computer and the Internet, these were mainly used by their children.

Table 6.1:
Summary of Questionnaire Responses - "Do you have a computer at home" and "Do you have access to the Internet at home" Items

	Yes		No		No response		Total
	N	**%**	**n**	**%**	**n**	**%**	**N**
Do you have a computer at home?	33	83%	6	15%	1	3%	40
Do you have access to the Internet at home?	30	75%	9	23%	1	3%	40

Contractors were generally surprised with the learning environment that was presented to them at the e-learning centre. According to contractors, a typical safety induction that is conducted in the oil and gas industry comprises groups of inductees engaging with safety content in a traditional trainer-driven manner. As a result, it is understandable that contractors with limited computer skills responded to the e-learning tool with some apprehension:

> Christ, I'm not that great with bloody computers. I did the basic things like ordering things from the stores, but that's just one program. Maybe I'm a bit intimidated at my age and my generation.
>
> I17a:18-20

> Computers just blow me away mate. I'd rather be face to face with someone learning.
>
> I18a:30-31

> Well I've never really been into the computer thing I suppose I am a computer illiterate really. I wouldn't even know how to turn them on really. But I found it interesting.
>
> I7:34-37

Only a few contractors described themselves as "computer illiterate" and even those that described themselves in this way were prepared to give it a go.

A number of contractors (according to safety advisers, about 50% of those that interacted with the e-learning tool) exhibited well developed computer skills. Most of these indicated a highly positive attitude towards the e-learning tool. Those that were

apprehensive about using computers to learn independently were generally "won over" by the benefits of being able to work at their own pace. There were exceptions, but these were rare and comprised of contractors who had very low levels of self-confidence with computers.

One of the challenges for Apache Energy is to put in place mechanisms that build ICT confidence quickly, so that levels of motivation fuelled by common conceptions of the importance of safety are not degraded by the requirement to engage with the e-learning tool.

6.2.3 The e-learning process

In the context of this study, the e-learning process refers to the broader implementation of the e-learning tool covering aspects such as learner autonomy, enjoyment and preparedness to undertake e-learning again (a measure of satisfaction with the e-learning process). Figure 6.1 provides a summary of responses to the Contractor Questionnaire on these aspects of the e-learning implementation.

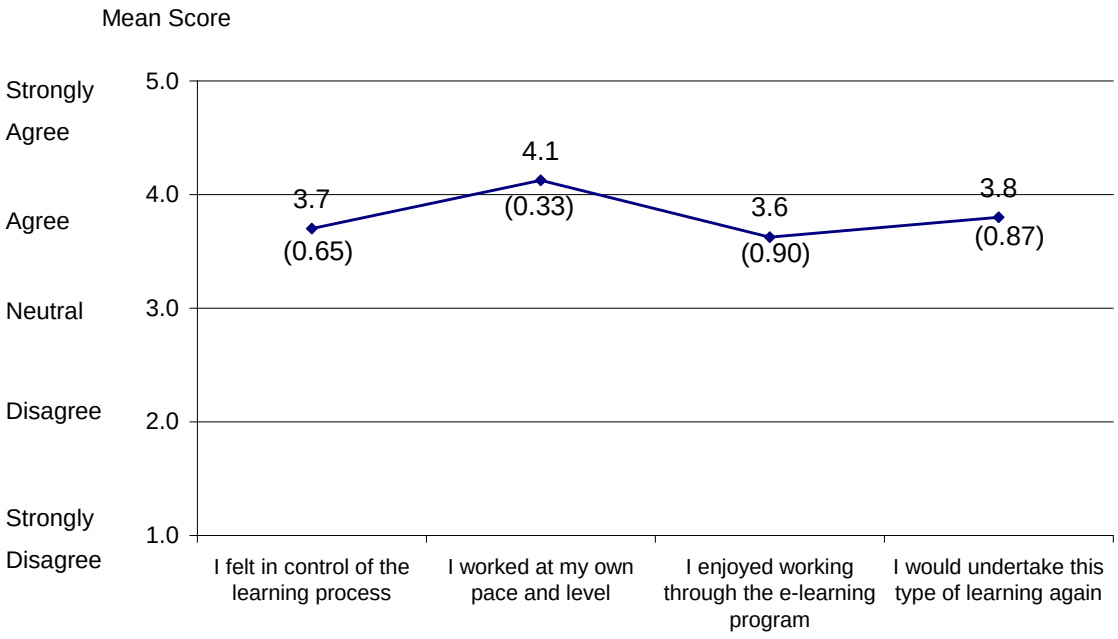


Figure 6.1. **Apache Energy e-learning tool questionnaire results: Mean scores and standard deviations on items relating to learner autonomy, enjoyment and preparedness to undertake e-learning again.**

A high level of agreement was noted in response to the item "I worked at my own pace and level", and respondents tended to indicate that they would engage with e-learning again. However, respondents were slightly less likely to feel in control of the e-learning process (possibly because of confusion with the navigation as described in Chapter 5).

In responding to the open-ended item of the Contractor Questionnaire "What did you like most about the e-learning program?" thirty one comments were made by respondents who shared what they liked most about the e-learning experience. The most common response (n=9) indicated support for the self-paced design of the e-learning tool. Examples of typical responses include:

> Working at your own pace.
>
> QL:19

> The ability to go straight to the test. As a contractor we do a lot of inductions.
>
> QL:12-13

> At your own pace learning.
>
> QL:24

The independent nature of the e-learning experience sometimes led to frustrations, particularly unwanted distractions:

> I was interested. I like computers so that was good, I just found that it was very distracting in there because someone else would move, and you'd see them. So the first day it was quite hard to concentrate on what I was doing.
>
> I201:30-33

> The only thing I found was when someone came in and talked to someone else it was distracting. You listen to them to see what they were saying. I just thought it was very easy to be distracted in there.
>
> I23a:40-43

> The distraction is people getting up and using that phone plus that guy going off where he's obviously not comfortable with the process. I just find that's what distracted me.
>
> I131:69-71

It is interesting that for some contractors, e-learning was actually less intimidating than a traditional classroom environment:

> It's good. A very impressive process. I was expecting to sit in class and watch a bloke talk. The way they've done it is good. It's not so intimidating. I don't find it so intimidating. I2:25-28

> If you miss something you can go back to it. If someone is talking to you, you can't say "can you repeat that" because you might sound like an idiot in front of other people. I23a:52-54

Many contractors exhibited a positive response to the proposed learning process. At the root of this response was the self-paced attributes of the e-learning tool:

> Because you learn at your own pace, you're not listening to somebody standing out there, you go to so many inductions when you work in the mining industry you fall asleep, well this one here you're learning and listening at the same time. I141:15-18

> I've just done many inductions over the years and there's all different types of people that do these inductions and you know it can drag on a bit, people are more interested in telling stories and asking possibly silly questions…you get the same sort of information out of it and you can go at your own pace. I151:30-34

> I think its something that you can do at your own pace. The explanations, the detail – it's in there. When you're doing something in a group, quite often if you don't pick up on something you don't put your hand up. Whereas here you can actually go back and review it at your own pace. I9:102-105

Overall, there was a high level of satisfaction with the way in which the e-learning tool was implemented and most contractors indicated that they would be prepared to use a computer to learn in the future:

> Yes I did find it satisfying the fact that I've never seen how blokes work offshore. I've never seen it before. So it was interesting to see how they do it and obviously a very high standard of safety which is what they're going to have. I2:79-82

> Yes. I think I would [undertake e-learning again]. It's just a better induction. It's better than sitting there listening to someone with a slide show. At the end of the day, it's better. I141:78-80
>
> The time went quick actually because you were chasing after the answers all the time. Maybe that was a better way than having an induction with somebody telling you all about things. I171:50-52

The data from the interviewing process suggests that contractors felt "compelled" to engage with the e-learning tool. Being a passive learner in a classroom environment was not an option in the e-learning centre. In a sense they "were forced" to become active learners as described in Chapter 5. Further, most contractors seemed to respond well to this. Some had done many inductions before and were bored by them so the e-learning process was a welcome relief. Others were simply busy and self-paced learning was a good use of their time. These issues will be further explored in Chapter 8, Discussion and Conclusion.

6.2.4 The relationship between social resources and the e-learning tool

In an educational institution, teachers may be encouraged to adopt strategies like scaffolding and/or skilled intervention (Collins, Brown, & Newman, 1989) that anticipate intervention to deepen opportunities for learning. However, in a corporate context, this level of social support might not always be possible. At Apache Energy, for example, there were three ways in which social resources supported learning in the implementation of the e-learning tool:

- An introduction to the e-learning environment is provided by the administrator of the e-learning centre.
- Administrative and technical support is provided during the e-learning experience by the administrator of the e-learning centre.
- Peer to peer communication and/or collaboration sometimes occurred spontaneously between contractors.

6.2.4.1 Introduction to the e-learning environment

The administrator of the e-learning centre provided each contractor with a brief overview of the e-learning tool. This introduction typically included information on:

- Basic navigation principles; and
- Apache Energy's requirements in terms of the assessment components.

In addition, to ensure that all contractors were aware of the e-learning process, a flow chart was developed by Apache Energy and made available in the e-learning centre. This flow chart is provided as Appendix F.

Most respondents appear to have been satisfied with the introduction provided. Figure 6.2 provides a summary of responses to the Contractor Questionnaire on aspects of social support for the e-learning tool.

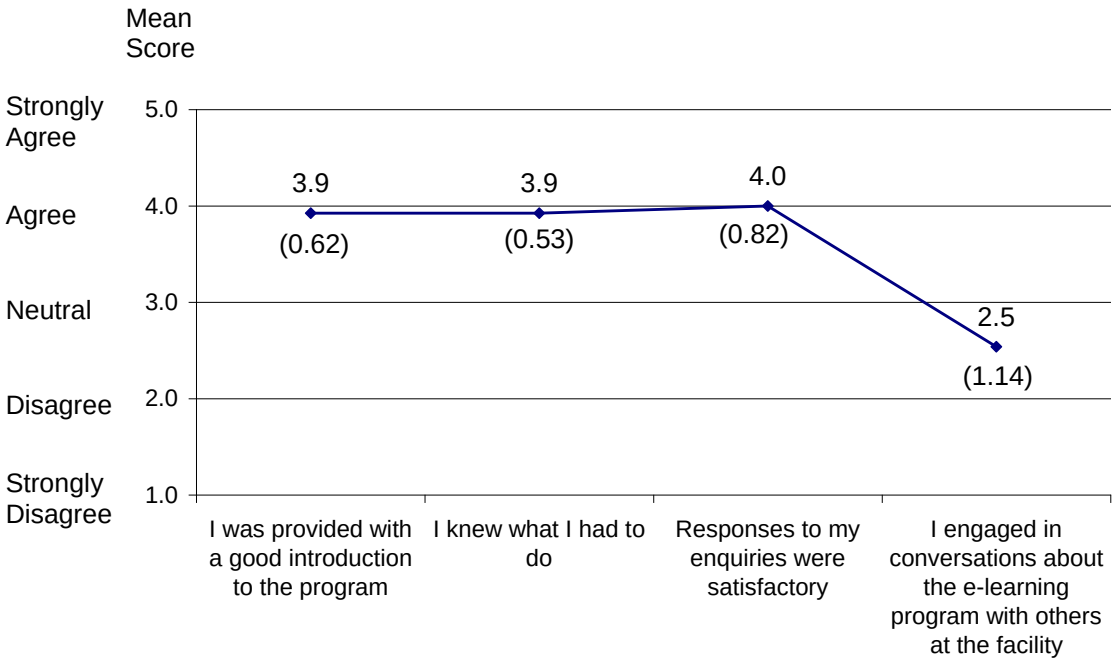


Figure 6.2. **Apache Energy e-learning tool questionnaire results: Mean scores and standard deviations on items in relation to social support.**

The introduction to the e-learning tool provided by the administrator of the e-learning centre seems to have been appreciated by most contractors, at least to an extent that they knew what they had to do.

6.2.4.2 Administrative and technical support provided during the e-learning experience

The quantitative data suggests that contractors were generally satisfied with the quality of responses provided to their enquiries (see Figure 6.2). However, the qualitative data reveals that some contractors felt that the tool was impersonal, and would have perhaps worked better had it been supported by a facilitator in the e-learning centre:

> Impersonal – not a good way of learning.
>
> QD:29

> The wording of some answers was difficult without having tutor input.
>
> QD:27

Some would have appreciated a little more facilitation perhaps through a blended approach:

> Would be better with more integration with a speaker.
>
> QD:5-6

> The computer had a lot of information, but I think that if you were sitting around talking to someone, you could get feedback from them where if you're just sitting at a computer you're working just yourself. The computer was quite good but sometimes its good to get broader and different ideas and opinions, I think it helps when other ideas come out of those things and improving the systems as well.
>
> I5:18-27

> This was good, but a little bit of direction now and again. I'm not a big fan of somebody standing in front like you just said. Just stand up waffling along because you do lose attention and you do miss points, and I think there is a lot to be said for this but with a little bit of direction sometimes.
>
> I8a:59-63

6.2.4.3 Peer to peer communication and/or collaboration

Most contractors did not seek interaction and/or collaboration with other contractors at the e-learning centre (see Figure 6.2) preferring to work independently at their own pace.

Many contractors were irritated by the prospect of listening to yet another induction and learning nothing new:

> Interviewer: So when you went into it, what were your initial thoughts about using the program, what did you expect?
>
> Contractor: I thought beauty, it's going to be a computer. I thought it was going to be a classroom, heaps of people, like what I had to do yesterday.
>
> I10:19-23

Interestingly, a couple of responses to the Contractor Questionnaire actually indicated a level of disruption/distraction at the e-learning centre, rather than seeing "distractions" as an opportunity to talk to others:

> Too close. Disruptions.
>
> QD:21

> Distraction of other people.
>
> QD:16

This may have been related to the time pressures that contractors were generally under to complete the induction so that they could attend to other matters.

Finally, some contractors found the prospect of communication/collaboration with others as intimidating, preferring to build their knowledge-base independently:

> It's good. A very impressive process. I was expecting to sit in class and watch a bloke talk. The way they've done it is good. It's not so intimidating.
>
> I2:26-28

Interventions that anticipate issues contractors may encounter and/or deepen opportunities for learning were absent at the case study site. The administrator of the e-learning centre was not empowered with the responsibility to anticipate teaching events and was physically situated away from the e-learning centre and only contactable by internal telephone.

6.2.5 Assessment of competency

Completion of two tests, designed to check the knowledge of participants in basic oil and gas safety requirements and the particular requirements of the permit system, was required by Apache Energy. Contractors had two opportunities to pass the test. There are 54 questions in the Check your Knowledge test that are presented in 13 segments. To pass the test, contractors must achieve a minimum score of 41 (76%) and cannot have more than one incorrect answer in any one segment. There are 46 questions in the Permit to Work test that are presented in 3 segments. To pass the test, contractors must achieve a minimum score of 35 (76%) and cannot have more than one incorrect answer in any one segment.

Figure 6.3 provides a summary of responses to the questionnaire on aspects of the assessment of the e-learning tool.

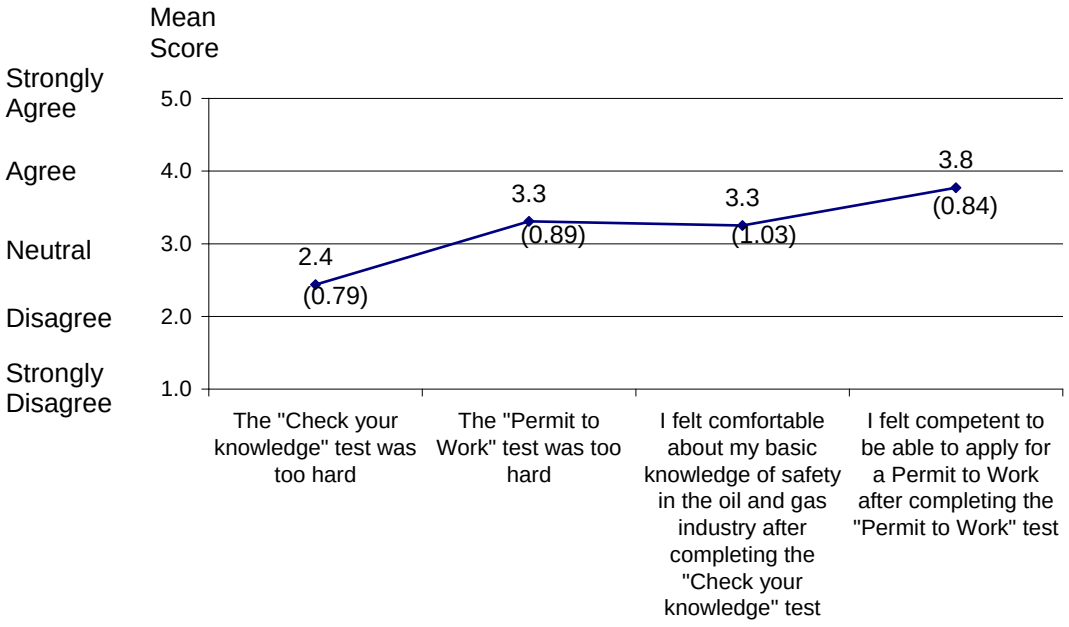


Figure 6.3. **Apache Energy e-learning tool questionnaire results: Mean scores and standard deviations on items in the Tests category.**

Contractors clearly had more difficulty with the Permit to Work test. However, once they had completed the test they generally felt satisfied with the knowledge they had gained (i.e. respondents felt reasonably competent to apply for a permit).

The Check your Knowledge test seems to have had the opposite effect. Contractors found that the test was not as hard, but did not feel particularly comfortable about their knowledge gained about safety in the oil and gas industry after completing the test. This could indicate that knowledge transfer was less effective in the Introduction to Oil and Gas component of the e-learning tool. It could also mean that the e-learning tool stimulated reflective thinking, causing respondents to become conscious of how much they did not know about workplace safety.

Only two responses were made to the question "Any comments on the tests?". These comments focused on the actual questions, suggesting that they were either confusing or ambiguous:

> Some questions confusing as taken in context of situation.
>
> QO:9

> There is some ambiguity in the Permit to Work section.
>
> QO:10

Overall, contractors appeared to be well motivated to engage with the e-learning tool. The data indicates a widespread acceptance of the self-paced learning model, but points towards difficulties in optimising the benefits of this through the articulation of the navigational attributes of the tool. The level of social support provided in the e-learning centre seems to have been adequate, although some contractors with limited computer skills clearly would have benefited from higher levels of support. The extent of collaboration between contractors was negligible, although this is not surprising given the strong tendency to want to engage in self-paced independent learning.

6.3 Observations

As part of the methodology, the researcher committed to making detailed observations of what contractors did when they attended the e-learning centre, how they responded to the introduction to the e-learning tool, what problems they encountered with the tool itself, and how they interacted with others at the e-learning centre. This data provides opportunities to triangulate other data collected through the Contractor Questionnaire and interviews.

The thesis will now profile two contractors who were observed and interviewed whilst engaging with the e-learning tool. The contractors were selected for detailed observation because they represented typical profiles, one of whom is young, inexperienced in working in an oil and gas setting, but competent with computers; the other being older, experienced in working in the oil and gas industry, but with limited competence with using computers.

What follows are two scenarios drawn from contractors that attended the facility in June 2005: James (I3) and Robert (I4). Fictitious names have been used. These scenarios illustrate the way in which many contractors responded to, and interacted with, the e-learning environment. They provide profiles that are typical of younger contractors that are familiar with computers and more mature contractors that have had limited opportunities to use computers. The scenarios are derived primarily from observation, but to provide a more complete picture that incorporates thoughts and feelings, they are augmented by data from the interviews that occurred immediately afterwards.

6.3.1 James

James is a single man of 26 years of age. He wants to make a good impression with Apache Energy, mainly because of his perception that he can gain financial security very quickly by working in the oil and gas industry on the North West Shelf. Although he describes himself as “good with his hands”, he is also comfortable with computers and uses email and the World Wide Web at least twice a week. He has a Certificate IV in Graphic Design and is going to Varanus Island as a Trades Assistant. James was offered casual employment with Apache Energy through his contracting agency that specialises in construction in the mining and oil and gas sectors.

Time	Event	Reaction
0900	Arrives at e-learning centre, signs in, collects an authentication tag and is welcomed to the e-learning centre by the administrator. Notices that there are four other contractors already in the room working through the e-learning tool. Is introduced to the researcher.	Expected a face-to-face induction. Was not advised by the contracting agency that the session would be in an e-learning format. Has never engaged in e-learning before. Apprehensive, but trusts his agency. Is in a positive frame of mind - he attended an enjoyable and informative helicopter crash survival course yesterday, and was very impressed with the fact that the agency paid all of his course fees.

0910	Provided with a quick run down of the e-learning tool and advised that this should be done in a sequential order from start to finish. Administrator is friendly and says that if there are any problems or questions, to pick up the phone and he would automatically be put through to her extension.	Still apprehensive, but notices that everyone else is busy working through the tool and thinks that this must be normal in the oil and gas industry. Is intrigued with the graphical and audio components of the e-learning tool and is willing to give it a go.
0940	Has worked through the tool in a sequential order for half an hour.	Begins to feel confident. Interactions are quite engaging and on pressing the forward button, a new screen appears every time with new information and instructions. Not wanting to "cut corners", he works through the tool methodically. He likes the way he can go back and forward, and in and out of things and hear narratives and watch short movies, and feels it is a good use of technology.
1030	Has completed the Introduction to Oil and Gas section and has gone back to the beginning. After a few clicks, realizes that he has been there before. Has forgotten what to do next. Everyone else in the room has earphones on so doesn't feel like disturbing them. Picks up the phone to speak to the administrator. Advised to undertake the Check your Knowledge test and then move on to the Permit to Work Section.	Undertakes the Check your Knowledge test. Feels the need to do well, and concentrates on each question wondering if "trick questions" have been designed to catch him out. Has been told that Apache Energy is very safety conscious and wants to be well equipped with information that may stop an accident or prevent a hazard from occurring.
1045	Check your Knowledge test completed.	Passed every segment, but noticed that he had got a couple of questions wrong, one in the area of Isolations that particularly concerned him. Goes straight to the Permit to Work content section. This is in the same format as the Introduction to Oil and Gas so no problems are encountered. Undertakes Permit to Work test. Notices that this requires more thinking.
1145	Permit to Work test completed	Passed every item. Told that the results will be emailed to the safety adviser on Varanus Island.
1150	Researcher requests interview	Agrees to be interviewed by researcher. Believes this has been a successful morning and feels reasonably well equipped to travel to Varanus Island. Suggests that the e-learning tool has helped to focus his attention in a way that a face-to-face session could not have done. Would have liked to know why he got the question on Isolations incorrect though.

Results of James' Check your Knowledge and Permit to Work test scores are attached as Appendix G.

6.3.2 Robert

Robert is 39 and is a boilermaker and first class welder. His contracting agency asked him to go up to Varanus Island to undertake some pipe fitting work. He has been working in the mining and oil and gas industries for nearly 20 years. He is married and has teenage children, and although he acknowledges that split shifts (2 weeks on/ 2 weeks off) have impacted on his family life, he believes that working as a contractor on construction projects in the North West Shelf is worth it. He has a computer and an Internet connection at home, but this is primarily for his children's use. He sees Apache Energy as just another oil and gas company, but believes that safety is of critical importance in these potentially dangerous environments.

Time	Event	Reaction
0850	Arrives at e-learning centre, signs in, collects an authentication tag and is welcomed to the e-learning centre by the administrator. Notices that there are two other contractors already in the room working through the e-learning tool. Is introduced to the researcher.	Visibly agitated by being placed in a position where he is going to have to use a computer. Has completed dozens of inductions in the past that were all done face-to-face. Was looking forward to sitting back and listening to a presenter and chatting with some other people that were going up to Varanus Island. Not happy about the situation, but feels powerless to do anything about it.
0900	Provided with a quick run down of the e-learning tool and advised that this should be done in a sequential order from start to finish. Administrator is friendly and says that if there are any problems or questions, to pick up the phone and he would automatically be put through to her extension.	Glances at the two people already working at the computers and sits beside one of them. Puts on the earphones and clicks the introduction. Listens to it and looks at the screen for about two minutes without doing anything. Finally clicks on the next button.
1020	Has worked through the tool in a sequential order for an hour and twenty minutes.	Spending less and less time on each screen as time goes on. Prefers to listen and click. When he is required to manipulate elements in the software (e.g. drag and drop), tends to have trouble with the mouse. At one stage (at about 1000), he got so frustrated with dragging an image in a confined space interaction that he did not complete it – just moved on.
10.30	Spontaneously asks another participant a question regarding the cross word (he was obviously struggling with it)	The other participant appears irritated by the interruption and says vaguely that "it doesn't matter, it's only for you guys". Continues working on the crossword but got more and more frustrated with it until he finally gives up and forward clicks.

1045	Has completed the Introduction to Oil and Gas section and has gone back to the beginning. Asks the researcher what he is supposed to do next. The researcher advises that he should go to the Check your Knowledge test and shows him where to click.	Undertakes the Check your Knowledge test. Takes a good deal of time on each question. Fails the test and asks the contractor next to him what to do. Contractor advises that he can have another go. Attempts the test a second time.
1115	Check your Knowledge test completed.	Fails the test after the second attempt. Is confused over where he went wrong except that the questions were related to the permit to work practices and confined space. Begins working through the Permit to Work segment and notices that it is in the same format as the Introduction to Oil and Gas. Takes less time to complete. Undertakes the Permit to Work test and after failing the first time, tries again.
1145	Permit to Work test completed	Fails Part B of the test. Contacts the e-learning centre administrator by phone and is worried that he will not be allowed to go to Varanus Island because he has failed both tests. The administrator advises that the results will be emailed to the safety adviser on Varanus Island, but it doesn't mean that he is not allowed to go.
1150	Researcher requests interview	Agrees to be interviewed by researcher. Is surprisingly upbeat about the experience of engaging with the e-learning tool. Acknowledges his lack of computer skills has meant that it took more time than he would have liked. Suggested that going over it a second time and not getting the information as to where he went wrong is not the best way to go.

Results of Robert's Check your Knowledge and Permit to Work test scores are attached as Appendix H.

The observations of James and Robert (and others) confirm that the implementation approach adopted by Apache Energy was successful. However, it did throw up a range of unexpected challenges. For example, in what circumstances is the self-paced, independent learning model most useful? How can the e-learning tool be tailored to meet the needs of contractors with a wide variation of computer literacy and prior knowledge in the resources sector? And how can the diagnostic attributes of the tool be best configured so that contractors leave the e-learning centre in a positive and

reflective mindset? These issues are examined in Chapter 8, Discussion and Conclusion.

6.4 Relationship between the design of the e-learning tool and its implementation

This section of the thesis responds to sub-research question 2.2: To what extent did the implementation complement the design of the e-learning tool?

This question will be addressed by examining the role and perceptions of the administrator of the e-learning centre and the safety advisers employed with Apache Energy. As discussed below, these participants are ideally placed to comment on the interface between the design of the e-learning tool and its implementation.

6.4.1 Perspectives of e-learning centre support staff

The e-learning centre is a critical component of Apache Energy's e-learning implementation strategy. It is the place where contractors come to engage with the e-learning tool and in many cases, get their first impressions of Apache Energy. The e-learning centre has a dedicated staff member that provides administrative and technical support to contractors. This staff member has a range of other duties and as a result of this is not physically located in the e-learning centre, but in an open office environment on the same floor. Picking up the phone in the e-learning centre automatically connects the contractor with the administrator of the e-learning centre.

To understand the role of the e-learning centre, and the actions of the staff that work within it, observation and interviewing techniques were adopted. However, before presenting these data, it is useful to provide a brief overview of the context in which the e-learning centre operates, particularly as this relates to its place within the oil and gas industry in Western Australia. The e-learning centre is managed by a company that is globally active in the oil and gas industry, primarily as a training provider but also in the area of e-learning materials development. It is a Registered Training Organisation (RTO) in Western Australia, operating out of metropolitan Perth.

The company's e-learning materials development arm, which tailors its products for the oil and gas and mining sectors, is based in Europe. These products are typically provided online. Apache Energy initially approached this developer of e-learning materials to explore opportunities for its proposed e-learning safety tool. However, the two companies could not agree on a price. There are very few oil and gas training providers in Western Australia and when Apache Energy decided to contract out the e-learning centre function, this training provider was asked to express interest and was ultimately successful. This created a sometimes tense situation with Apache Energy championing its own e-learning tool, and e-learning centre staff exhibiting more lukewarm sentiments towards the software.

The following transcript was taken from an observation of an introduction to the e-learning tool by the administrator of the e-learning centre. The introduction began at 9.10 am and was completed in just over one minute. The contractor was later interviewed (I10). The researcher observed a number of introductions, and this was a typical example:

Contractor I10	**Administrator of the e-learning centre**
	The next section is the Introduction to Oil and Gas and that's the test that goes with that and then Permit to Work, and that's the test that goes with that *(Administrator uses the mouse to point to the relevant icons).* Alright?
Yes	I'll just click here to show you a couple of things. In order to move around this you need to click on this. Don't use these navigation buttons because they will take you to different areas and you will lose completely where you are *(Administrator uses the mouse to point to the top navigation buttons).* Alright?
OK	I'll just show you some quizzes and crossword puzzles and things like that. They are very good to work through because it helps you with information that you need at the end of the day. But they are only quizzes, they are not the actual test. If you get stuck on it, there's no need to get worked up about it. Work through as much as you can, but it's not the actual test.
	The test itself is this Check your Knowledge *(Administrator uses the mouse to point to the Check your Knowledge icon).* And the Permit to Work is that one *(Administrator uses the mouse to point to the Permit to Work test icon).* But you need to work through all of these before you do the tests.
	So if you want to click on there and go through the video. And once again if you get stuck on anything, give me a shout on the phone just there.

It is unfair on the administrator of the e-learning centre to be overly critical of the introductions that were provided to contractors. The administrator did not receive any directions on how to introduce the tool (other than the flow chart provided by Apache Energy, Appendix F), or any advice on its design features. She had not been introduced to e-learning outside of the corporate sector, and received no professional development in facilitation or mentoring. Further, the administrator has no teaching/training qualifications. However, the following reflections are pertinent to providing a complete picture of how the e-learning tool was implemented. The administrator of the e-learning centre did not:

- Relinquish control of the mouse during the introduction.
- Ask the contractor if he had any questions.
- Address the contractor by name.
- Ask the contractor about his prior knowledge or computer skills.

Further, in the preceding example two instructions were provided that were contrary to the design features that underpinned the tool: the first was specifically telling the contractor not to use the top navigation buttons which were designed so that users could explore and self-select; and the second was to suggest that the contractor needed to work through all of the pages before attempting the tests. These ran contrary to the design of the tool which sought to recognise the variety of contractors' prior learning experiences, and provide multiple entry and exit points that are cognisant of prior learning.

This indicates a mismatch between the design of the e-learning tool and the way in which the administrator of the e-learning centre interpreted it. It is not surprising therefore, that some contractors were confused about aspects such as navigation, since this was not explained to them.

The administrator of the e-learning centre has a perspective about e-learning that resembles a particular type of pedagogy:

> An effective tool would be something where you just sat down, and put the head sets on and worked through in a methodical fashion.
>
> I24:123-124

> Most people sitting down on an e-learning module, they just want to be able to go and click one page to the next page, to the next, to the next, until they're finished. They don't really want to have to move around too much.
>
> I24:149-152

Within this model of learning, the quality of the software is vitally important, and "getting through" with the minimum of fuss is the measure by which quality is judged:

> For induction purposes, I think it's a great tool to use providing the software is up to scratch. I've seen various e-learning products. Some of them have really good software that is easy to get through. Others could do with a bit of tweaking and have a bit of improvement on it. The other thing of course, it depends on what industry it is and what kind of people are using it. So people who are computer literate whiz through it no problem, other people are a little bit more challenged and find it a bit harder.
>
> I24:22-30

These perceptions of e-learning guided the way in which the Apache Energy e-learning tool was presented to contractors, and influenced the type of support that was provided. The administrator of the e-learning centre saw her role as a facilitator in an administrative and technical, rather than pedagogical, sense:

> Well my role is really as a facilitator, someone to help them get stuck into the e-learning, set it up for them. If they need any help in navigating through the e-learning itself, through the actual software.
>
> I24:35-38

It is not surprising that the administrator of the e-learning centre was less than satisfied about the e-learning tool since it rated poorly on criteria of ease of being able to "get people through". More challenging aspects of the e-learning tool such as formative interactive quizzes were not seen as the best way to communicate information:

> There are quizzes inside the main body of information and people are getting confused thinking that this is the test when it's not. Is that really the best way to communicate information or should we do it a different way?
>
> I24:56-58

Responses to interview questions levelled at the administrator of the e-learning centre tend to suggest that improvement of the tool is integrally bound up with ideas on how to reconfigure the design to make it a medium for the transmission of information rather than the construction of knowledge. These attitudes towards the tool came through in the way in which the tool was introduced to contractors, and therefore impacted on the type of learning that emerged.

The administrator of the e-learning centre exhibited a “software centric” mindset on e-learning that differed starkly from another important stakeholder involved in the implementation of the e-learning tool: safety advisers.

6.4.2 Perspectives of safety advisers

Apache Energy safety advisers closed the loop on the e-learning tool. These were the employees that were empowered by Apache Energy to be the "gatekeepers" for safety, making daily decisions on whether individuals were equipped with acceptable knowledge and skills to conduct work at Apache Energy oil and gas facilities. They also had a formative role, helping employees and contractors with safety issues and safety planning. There are three safety advisers employed at Apache Energy in Western Australia.

If the tool is implemented effectively, the safety advisers’ job is relatively easy, diagnosing and assisting contractors with gaps in their understandings of workplace safety. If the tool is implemented poorly, on the other hand, they will bear the brunt of contractor frustration and dissatisfaction. The researcher interviewed two safety advisers to attain their perceptions on the e-learning tool and its implementation.

Both safety advisers agreed that the general concept of providing a self-paced e-learning tool off site, supplemented by safety adviser verification of understandings on site was an appropriate model:

> I think one complements the other. You have the individualistic session where you have to interact with the computer, and then the on site stuff where you’re dealing with safety advisers and on site supervisors.
>
> I25:259-263

In fact, when asked what an "ideal" learning environment would look like, one safety adviser actually described the Apache Energy implementation:

> The ideal learning environment is one where as many senses are exposed as possible. That's the ideal learning environment in my opinion. In this case I think a collaborative approach is the way to go. In that way you've got interaction with a computer and you have to think for yourself, but you're completing that feedback loop where you've got interaction with a person on site who is able to clarify questions and extend your own knowledge.
>
> I25:325-334

Both safety advisers felt that the content embedded within the e-learning tool was appropriate:

> Researcher: The content in the program. Do you find that it's relevant to what they [contractors] are doing up there?
>
> Safety adviser 1: Yes definitely. We might have missed out on a few things but they would be there for another hour with all of the different certificates.
>
> Safety adviser 2: Absolutely. With all the quality control, we're spot on with the content.
>
> I25:134-140

In acknowledging the overall soundness of the content and the approach, safety advisers did point out that there were some challenges to overcome to enable the implementation of the e-learning tool to be congruent with its design. These can be broadly categorised as perceived computer skill deficiencies and e-learning centre support practices.

6.4.2.1 Perceived computer skill deficiencies

From the safety adviser's perspective, one of the biggest challenges to overcome in developing an effective implementation of the e-learning tool is computer illiteracy:

> One of the only factors that is effecting this tool that we have is, I suppose, the pre-existing knowledge of the people that are coming up to the Island, and their experience with dealing with computers. I get a lot of people who are computer illiterate, as such, and are afraid to use computers, and I think that may be resulting in people failing because they are afraid.
>
> I25:22-27

Safety advisers put contractors' computer skills deficiencies down to a combination of two factors: age and occupational background:

> …a lot of the older people: very confused.
>
> I25:41-41

> I was surprised with how many of them don't work with computers. But if you look at what they are doing: paving, boilermaker, rigger. Why would you? When they go home they don't sit on a computer. We're on it all the time.
>
> I25:224-227

The conclusion reached by safety advisers was that, because of computer literacy issues, many contractors were not ready for e-learning:

> A lot of these contractors are definitely not ready for it.
>
> I25:221-221

> I think they are failing because of IT. I had one guy who did it twice [under a different name]. And I quizzed him about it, and he said "there was no one to ask so I just started again".
>
> I25:266-270

> Getting the feedback from the guys, it's the IT issue. Just things like I don't know where to click, I didn't know you could do that. They never come up and say "the question was too hard". It's getting to the question.
>
> I25:300-303

The issue identified by safety advisers – that e-learning was beyond the capabilities of some contractors – if true, has implications for both software development and support. On the aspect of software development safety advisers offered some suggestions for the improvement of the design of the e-learning tool, particularly in relation to being able to go back and correct answers in quizzes. On the aspect of support for contractors, they were critical of the *lack* of support that was provided at the e-learning centre.

6.4.2.2 e-Learning centre support practices

Whilst computer literacy was perceived as something that was out of the control of Apache Energy (it was believed that this would just change over time with a younger demographic coming through), safety advisers believed that e-learning centre support

practices were certainly within their sphere of influence, and should be attended to urgently:

> I think our biggest problem, and this is what we've got to look at is that when they go to [the e-learning centre] they're given no help. It is "there's the computer, when you've finished just walk out". And they've gone "what do I do now". And us as a company, we need to sort that out.
>
> I25:42-45

> There was no support at all from [the e-learning centre]. They would just get in there and "what do I do now" you know. And that's the type of feedback we're getting.
>
> I25:68-70

> For us as a company we need someone down there that can help the people who are struggling.
>
> I25:296-297

> They like it, but it would be nice to say "excuse me, can you explain this to me". There's no one there. It's like me sitting in this room on my own.
>
> I25:124-126

Safety advisers appeared to wish for a level of learner support to which the management of Apache Energy was not prepared to commit. They were critical of the way in which the e-learning tool was supported, particularly in relation to helping contractors with minimal computer skills to derive more benefit from the tool.

Overall, however, safety advisers exhibited a very positive attitude towards the implementation of the e-learning tool. They supported the model of implementation that cast them in a role of authenticating understandings on site. Further, they were enthusiastic about self-paced e-learning as a potential solution to help combat the issue of contractors' deteriorating motivation levels on attending multiple inductions.

There seems to be only one critical discrepancy between the design of the tool and its implementation, and this was in the area of the social support that should be provided at the e-learning centre. Effective learning design recognises the importance of learner support mechanisms, and of providing scaffolding processes to assist learners to engage more actively with e-learning materials (e.g. Oliver, 2001). However, from the point of view of the e-learning centre administrator, the software should be able to mediate all of the required learning. Social support provided was minimalist and

limited to administrative issues. Conversely, from the point of view of safety advisers, support should be improved particularly for those contractors that did not have well developed computer skills.

6.5 Summary

Data from observations, the Contractor Questionnaire, and interviews confirmed that the e-learning tool tended to engage contractors in ways that are difficult in face-to-face inductions because of the number of inductions that contractors are required to attend. The self-paced attributes of the tool were particularly well received, and although most contractors did not seek to interact with others, some may have benefited from initial support in navigational aspects that may have assisted in contractors being able to use the tool to meet their specific requirements. Finally, there was some confusion over the diagnostic functions of the tool and many contractors left the e-learning centre without knowing where they went wrong in the tests and why.

Data from the administrator of the e-learning centre suggested a familiarity with a particular type of e-learning. Safety advisers called for more emphasis to be placed on supporting the tool, particularly for those that were not experienced in using computers. This was the main point of friction between the design of the e-learning tool and its implementation.

The issue of tailoring the e-learning tool for an individual contractor's needs (e.g. providing or presenting appropriate scaffolding options depending on the type of contractor that is engaging with the tool) is a recurrent theme that is explored further in Chapter 8, Discussion and Conclusion.

Chapter 7 will now examine the findings to emerge from Phase 3 of the study.

CHAPTER 7
Findings:
Outcomes to emerge

7.1 Chapter overview

This chapter presents the findings that emerged from Phase 3 of the study: Explanation of the outcomes to emerge as a result of the implementation of the e-learning tool. This phase specifically dealt with research question 3:

To what extent does the implementation of the e-learning tool achieve desired outcomes?

The chapter begins by describing the desired outcomes from the perspective of Apache Energy (sub-research question 3.1: What were the desired outcomes to emerge?).

It then discusses the extent to which unplanned learning outcomes emerged – sub-research question 3.2: What were the unplanned learning outcomes (if any)?.

The chapter then explores the relationship between the implementation of the e-learning tool and:

- desired outcomes (sub-research question 3.3: What were the features of the implementation that influenced achievement of desired outcomes?); and,
- unplanned learning outcomes - sub-research question 3.4: What were the features of the implementation that influenced achievement of unplanned learning outcomes (if any)?.

The chapter concludes by providing a consolidated summary of chapters 5 to 7.

7.2 Achievement of desired outcomes

This section responds to sub-research question 3.1: What were the desired outcomes to emerge?

As discussed in Chapter 1 from the perspective of Apache Energy, the primary rationale for developing an e-learning solution was to provide a rigorous off site safety induction to an increasingly contracted workforce. The three key components of this rationale are:

- The efficiency objective: Movement of the safety induction process from on- to off-site.
- The effectiveness objective: Development and implementation of an effective e-learning design that stimulated learning.
- The flexibility objective: Implementation of an e-learning tool that was flexible in that it facilitated learning at a time and pace that was appropriate to a contracted workforce.

These components are now dealt with in detail.

7.2.1 The efficiency objective

The transfer of the safety induction process from on site to off site was an expensive exercise. The development of the tool itself cost $125,000 and took nine months to build. Maintaining the e-learning centre is approximately $25,000 per annum. These costs do not include the time that safety advisers and management have spent inputting into the development of the tool, and ongoing Apache Energy administration of the contract with the e-learning centre.

In crude terms, the 256 contractors that went through the e-learning centre between May and December 2005 did so at a cost to Apache Energy of $390 per person. That is, the cost of developing the e-learning tool and maintaining the e-learning centre over an 8 month period divided by the number of contractors that attended the centre

during this period. However, with contractors arriving on site ready to work, a minimum of a half a day (4 hours) in productivity has been reclaimed - a total of 1024 working hours. At offshore rates for skilled workers between $60 and $100 per hour, this equates to productivity gains of $60,000-$100,000 in the first 8 months. The time of safety advisers is also freed up to focus on other Apache Energy priorities.

In future years, where maintenance of the e-learning centre is the only recurrent cost, the efficiencies brought about by the implementation of the e-learning tool will be significant, particularly if large numbers of contractors continue to work with Apache Energy on construction and development projects.

These efficiency drivers and potential benefits of e-learning are recognised by Apache Energy management:

> It's something that I suppose has been bugging them [operations managers] for quite some time, and it came to a head when we had contractors on site that were running around doing nothing but inductions for the first day.
>
> I23:54-58

> There is a cost benefit, especially if we are paying up front, for that person to be on offshore rates. The other thing was if they are arriving to do an induction on the Island, you've basically wrote off a full day even though the induction was only taking three to four hours because of interruptions, the whole works – you've lost a day. And that's costing.
>
> I23:22-24

> By doing the e-learn we can now have all of the inductions done in Perth and people arrive on site ready to go to work.
>
> I23:22-24

A thorough investigation into return on investment (ROI) will no doubt be undertaken by Apache Energy as part of the ongoing management of its operations. However, data indicates that the e-learning tool has achieved its efficiency objective.

7.2.2 The effectiveness objective

In the context of this study, the desired learning outcomes are those which were expected to occur on engaging with the e-learning tool, and which were measured

through formative testing. Contractors were asked to complete Check your Knowledge and Permit to Work tests as part of the e-learning process. These two tests comprised 100 items and contractors were required to achieve at least 76% in both tests in order to pass. In reality, this pass grade was an arbitrary measure and the tests were used purely as a diagnostic tool for safety advisers to satisfy themselves that contractors would exhibit appropriate behaviours when conducting work on site.

Figure 7.1 shows the average scores that were attained by contractors between May and December 2005 on both the Check your Knowledge and Permit to Work tests.

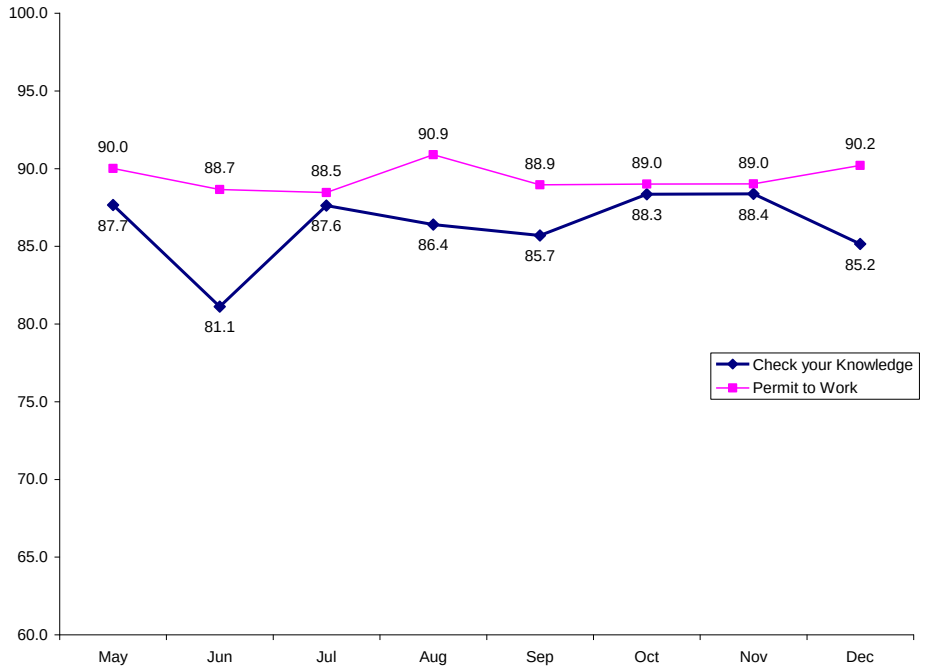


Figure 7.1. **Average scores on Check your Knowledge and Permit to Work Tests: May-December 2005.**

Given that the pass rate is 76% on both tests it is evident that most contractors demonstrated minimum standards required to work on site.

One of the weaknesses of test scores as a measure of the learning that took place is that there was no pre-testing so it was difficult to gauge what impact the e-learning tool had on the overall demonstration of competency. As previously discussed, it is probable that many contractors had well developed understandings of workplace

safety before engaging with the e-learning tool. Nevertheless, it should be acknowledged that Apache Energy facilitated a process whereby contractors were able to demonstrate an acceptable level of safety understanding.

During interviewing, discussions emerged about the effectiveness of the e-learning tool in stimulating learning. It is clear that many contractors appreciated the opportunity to engage with the e-learning tool in a self-paced manner. Further, most contractors felt that the design compelled them, and their peers, to better engage with the subject matter and take responsibility for their learning. This is evident in the following extracts:

> It was good because you can concentrate without four or five different students in the class answering questions for you. When you're doing an induction and someone is answering a question and he is writing. You're doing it yourself, you know.
>
> I11:33-36

> I think it keeps you more alert. When you've got a lecturer I guess you sort of sometimes wander away and look out the window, but with that you've got the earphones on, you've got the computer and it's a lot more hands-on. It's you and the computer. It's more of like a one-on one sort of thing than a lecturer with a group of people. So your attention is very much focused on the software. I thought it was really good.
>
> I3:64-69

> Yes. Generally the industry inductions are "sleep" and a lot of guys do sleep, which is probably a positive thing about e-learning is that you do have to engage with it.
>
> I4:60-62

> You've got to really do the quizzes and do the answers. It forces you to do it, whereas a lot of times a guy stands in front and talks to you for an hour and you fall asleep. And in the end you get helped through some of the answers.
>
> I8:44-47

These excerpts indicate that contractors actively interacted with the e-learning tool. Indeed, the compelling nature of the tool, for many, contributed to a level of learning that did not normally occur in instructor driven environments:

> Researcher: And would you recommend using this type of package to your workmates?
>
> Contractor: Yes, I know more about Apache's safety requirements than any of the other companies I've done work for.
>
> Researcher: Would you put that down to the program?
>
> Contractor: Yes, absolutely.
>
> I201:62-67

The study included one interview where the contractor's second language was English. This contractor (who was confident with using computers), felt that he learnt more through engaging with the e-learning tool:

> It was good. I learnt more.
>
> I191:3

For some experienced contractors, the e-learning tool clarified and consolidated current practices:

> I think it did clarify the permit system when I look at it. I've taken out permits in the past and I was basically just following the Permit Authority and didn't know what I was supposed to be doing. This clarified what I was supposed to be doing.
>
> I4:97-100

Overall, the qualitative data suggests that the e-learning tool may have been responsible for higher levels of engagement than would have been otherwise possible through a traditional face-to-face safety induction process.

This seems to have been translated into a more effective learning process. The relatively high average scores for both Check your Knowledge and Permit to Work tests corroborate this observation, although there is no measure of the prior knowledge of contractors and no previous testing in which to gauge the effectiveness of the e-learning tool.

The learning process did not conclude on completion of the tests. Closure of the process occurred on site when safety advisers diagnosed results and helped contractors to fill in their knowledge gaps.

As one safety adviser put it:

> If we…find a person with zeros and ones when they should have had sevens and eights then we might have concerns about them leading a group of people with a permit. We'll also need to take them away and give them a little more extra tuition on the island on a one-to-one basis. The aim of the e-learn program is to give us an understanding of their basic level of knowledge, not whether or not they are Einstein's. That's where we've put too much expectation on the course itself.
>
> I23:182-189

The diagnostic capacity of the e-learning tool could be considered as an attribute that contributed to desired learning outcomes since it stimulated an on-site response (i.e. the safety adviser provided the contractor with some one-on-one coaching on the perceived areas of concern).

Figures 7.2 and 7.3 show how the e-learning tool helped to identify "problem areas" in relation to workplace safety. Figure 7.2 compares results of the Isolations questions with the average results for the Check your Knowledge test.

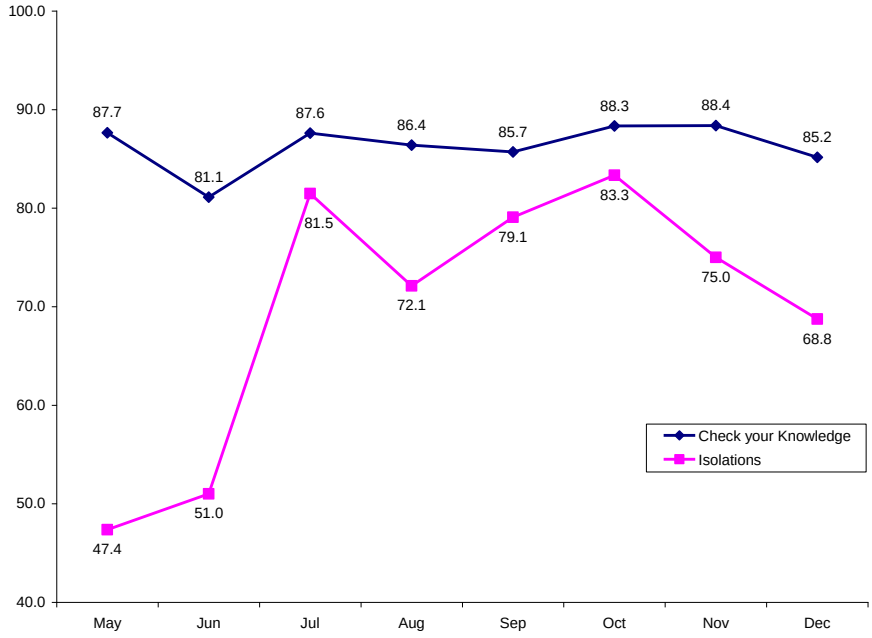


Figure 7.2. **Average scores for Isolations items in comparison to overall Check your Knowledge Test averages: May-December 2005.**

Clearly, understanding Process Isolations and appropriate tagging processes was an area of concern for many contractors. The test data on Isolations caused Apache Energy - at management level - to look at possible ambiguity in the questions in the test, but also the organisational issue of clarity of the tagging processes in general. Improvements were made on both counts.

Figure 7.3 compares results of the Hazard Identification and Preparation items with the average results for the Permit to Work test.

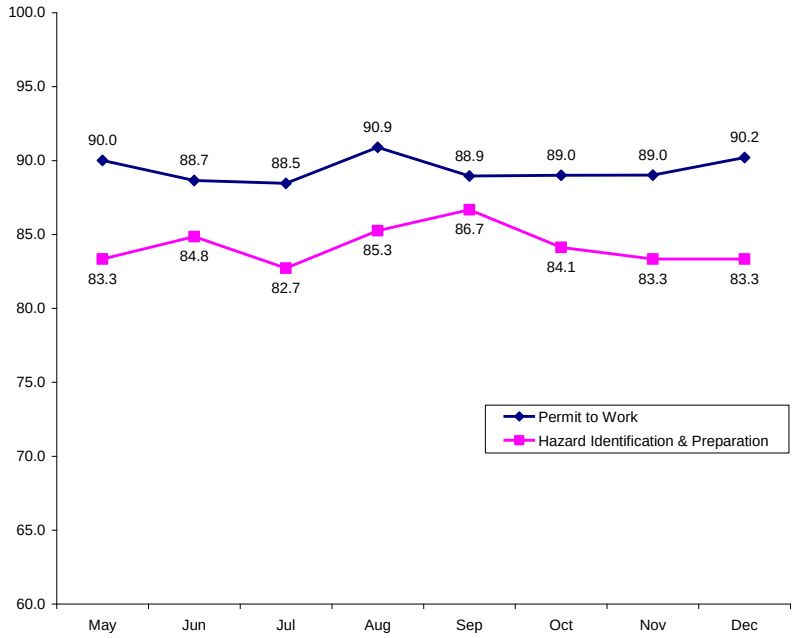


Figure 7.3. Average scores for Hazard Identification and Preparation items in comparison to overall Permit to Work Test averages: May-December 2005

It is evident that the identification of hazards and the preparation of the workplace to minimise exposure to these hazards was also an area of concern. Again, this was taken up by safety advisers. There were also suggestions for further development of the e-learning tool to provide a further interaction on hazard identification in specific work contexts.

The above examples indicate that Apache Energy was prepared to make improvements to the e-learning tool that benefited both organisational and learning processes.

7.2.3 The flexibility objective

Apache Energy believes the implementation of the e-learning tool has been done professionally and according to effective learning principles. One of the key objectives, in terms of the learning design, was to offer contractors flexible opportunities to engage with the tool:

> We wanted to give flexibility to the people themselves who were turning up, so we've implemented it through a learning centre that has been set up specifically for us. The guys come in at their leisure basically at any time during their work day Monday through to Friday and they basically book in. Arriving at the strategy I think it was more a case of how can we make this as easy as possible to get people through.
>
> I23:8-13

> At the moment what I think we've got is a fairly aesthetic learning environment. The learning environment that we've set up, there are six bays in the learning centre, it's fairly well set out, people have got access to it. It's fairly flexible. I don't see, from the point of view of making it flexible and appealing, there's not an awful lot more we can do.
>
> I23:193-197

Whether contractors interact with the tool as individuals or in groups is of little concern to Apache Energy. As far as the implementation of the e-learning tool is concerned, the company sees its responsibility as having four components:

- Provision of e-learning content targeted at safety in the oil and gas industry.
- Set up of an environment in which contractors can interact with this e-learning content.
- Development of a mechanism in which the demonstration of understandings about safety in the oil and gas industry can be measured and interpreted.
- Maintenance of an on site process to either (a) help contractors who have not demonstrated understanding about safety in the oil and gas industry come up to

speed or (b) prevent such contractors engaging in work in environments that carry unacceptable levels of risk.

From Apache Energy's perspective, how contractors engage with the e-learning tool is for them to determine:

> I think the major issue is do they have the knowledge. How they get that knowledge and how that knowledge is transferred is entirely up to the individual. I don't have a problem with them talking about it. In actual fact we've had thoughts about, especially with people having difficulties, of running it in group sessions.
>
> I23:140-145

From an Apache Energy management point of view, the implementation of the e-learning tool has been very successful. It has provided a cost effective mechanism to solve a significant safety issue. Whilst management recognises that improvement opportunities will always exist, it is of the view that by putting in place relevant e-learning content, a well-equipped facility, a rigorous testing mechanism, and acknowledging an on-going role for safety advisers, that it has successfully implemented an important flexible learning initiative.

7.3 Unplanned learning

This section responds to sub-research question 3.2: What were the unplanned learning outcomes (if any)?

For the purpose of this thesis, unplanned learning is understood as knowledge that is constructed on matters that are outside of the scope of the learning design. In the context of the Apache Energy e-learning tool, two possible areas of unplanned learning were specifically targeted in questioning during interviews: the development of computer skills and the development of knowledge about workplace safety in areas that were not covered in the design.

One of the questions posed to contractors during interviews was: "Do you believe that using the computer to learn has provided you with any extra knowledge than that which was expected? If yes what?"

When confronted with the above question, most contractors pointed out that the e-learning tool did not provide them with any extra knowledge, just a more convenient and better way of attaining the required knowledge. However, some contractors suggested that their computer skills had been enhanced through engaging with the e-learning tool:

> For me the main thing was how to use a computer because I'm not really familiar with a computer so that would have been one of the main things. But just a lot of things. Safety and the natural resources. How it is extracted from the ground stuff like that.
>
> I1:84-87

> How to use a computer.
>
> I11:114

> Yes, in that sense I would say that I feel more confident in using a computer. I'd say that's one area that I would say yes it's definitely helped.
>
> I7:200-201

> I'd do it again. I know how to use it now. Like I said the more time you spend on something, you're going to pick up more things all the time it's like anything.
>
> I11:157-159

It is difficult to gauge the depth of learning that has taken place through the e-learning experience. The qualitative data suggests that many contractors believed that e-learning was just an alternative method which allowed them to engage with the content more time efficiently and effectively. Whether this then led to reflection on the learning about safety issues or indeed in relation to the learning process itself is hard to gauge, particularly in the light of the relatively short time that contractors were available for observation and interview.

A more appropriate method of collecting data may have been to pre-test contractors' understandings of safety issues and also computer literacy and compare these data with test scores. However, this may have been intrusive on Apache Energy's and contractors' time. Further, it probably would only answer questions about short-term memory retention rather than whether any deeper learning occurred. Some ideas for

further research into measuring unplanned learning are proposed in the conclusion of this thesis.

7.4 Relationship between the implementation of the e-learning tool and desired outcomes

This section responds to sub-research question 3.3: What were the features of the implementation that influenced achievement of desired outcomes?

An analysis of the findings from Chapters 5-7 revealed a number of inter-related, and in some cases, overlapping themes that positively and negatively influenced the implementation of the e-learning tool. These themes are:

- Acceptance of the self-paced learning model.
- The value of tailoring.
- The absence of the social dimension to learning.
- The compelling nature of multimedia interactivity.
- Transparency of diagnostic processes.

7.4.1 Acceptance of the self-paced learning model

Self-paced learning emerged as the most significant positive aspect of Apache Energy's implementation of the e-learning tool. It was almost universally accepted as a unique and advantageous feature of the e-learning design. Throughout the interviewing process with contractors, and through the questionnaires, support of the self-paced attributes of the learning experience was repeatedly highlighted by a broad range of contractors. Acceptance of the self-paced attributes of the e-learning tool is directly linked with Apache Energy's flexibility objective.

7.4.2 The value of tailoring

Providing learners with the best possible learning opportunities - for them - is one of the great challenges for educators. In the context of Apache Energy, tailoring the

e-learning tool to best meet the needs of individual contractors is integrally bound up with recognising prior knowledge. The recognition of prior knowledge aspect of the e-learning tool was under-utilised in the implementation. Strategies to better integrate recognition of prior knowledge into the e-learning tool (e.g. a more comprehensive introduction to the tool itself) might improve performance against Apache Energy's effectiveness and flexibility objectives. Although from a learning perspective, tailoring the e-learning tool to an individual contractor's needs has the potential to further improve performance against Apache Energy's effectiveness objective, there are costs associated with this that might adversely impact on Apache Energy's efficiency objective. Strategies that anticipate support for contractors needing help (e.g. locating the e-learning administrator in the e-learning centre) might improve performance against Apache Energy's effectiveness and flexibility objectives. However, it is acknowledged that there may be costs associated with tailoring the e-learning tool to an individual contractor's needs and that these costs need to be balanced with other efficiency objectives.

7.4.3 The absence of the social dimension to learning

In developing the e-learning tool, Apache Energy took a position that developing a learning model to encourage social interaction was not in the best interests of most contractors. Given the widespread support for the self-paced learning model, it is not surprising that opportunities for discussion and collaboration were not seen as important. For more complex learning situations that require higher levels of abstraction, Apache Energy supports and facilitates hands-on professional development activities using group work, and even online interaction. However, in relation to basic safety understandings aimed at contractors, who potentially may only work with Apache Energy for a brief period of time, the e-learning design and its implementation largely ignored the social dimension to learning.

7.4.4 The "compelling" nature of multimedia interactivity

Most contractors acknowledged that they learnt *more* by engaging with the e-learning tool simply because they had to. In the e-learning centre they were "forced" to interact with the tool; whereas in a traditional classroom based environment they could "switch off". Thus the very nature of the e-learning tool and

its implementation ensured that contractors took responsibility for their own learning. The compelling nature of the e-learning tool is directly linked with Apache Energy's effectiveness objective.

7.4.5 Transparency of diagnostic processes

The rationale for the diagnostic process was not clear to contractors. On attending the e-learning centre many contractors believed that the e-learning experience involved summative testing for the specific purpose of precluding the contractor from attending site if they failed. Instead, Apache Energy sees the e-learning tool as a formative and diagnostic process: essentially identifying areas in which the safety adviser can focus on, once the contractor has reached site. The diagnostic functions of the tool were not made clear to contractors as part of the e-learning introduction and this may have adversely affected the learning to take place.

The above themes are unpacked in Chapter 8, Discussion and Conclusion.

7.5 Relationship between the implementation of the e-learning tool and unplanned learning

This section responds to sub-research question 3.4: What were the features of the implementation that influenced achievement of unplanned learning outcomes (if any)?

The data presented in Chapters 5-7 revealed that unplanned learning was generally subverted. Possible reasons for this include:

- The design of the tool limited engagement with content beyond the scope of the tool (e.g. there were no activities that required contractors to research safety concepts and/or explain these in their own words). The tool was targeted at basic safety understandings with a view to contractors eliciting these understandings and behaving appropriately on-site.
- The e-learning design did not support the use of social resources beyond technical and administrative assistance. In most cases, this resulted in an

independent e-learning experience. There was limited discussion and debate in which contractors could share their thoughts and ideas about safety concepts. This may have occurred once contractors had left the e-learning centre (e.g. on-site). The design of the e-learning tool, however, did not explicitly promote discussion. It should be stressed that, with the exception of contractors with limited computer skills, the absence of social interaction – both with a facilitator and with other contractors in the e-learning centre – was almost universally viewed as a positive (rather than negative) attribute of the learning design.

- The time-scarce context in which contractors operate limited opportunities to deepen safety understandings as, in many cases, they were balancing competing priorities for their time. Further, from Apache Energy's perspective, contractors may potentially only work with the organisation for a brief period of time. A financial investment for learning beyond a basic safety introduction was therefore questionable.

For those with limited computer skills, it is possible that the e-learning tool provided a mechanism in which their skills could be enhanced. For example, some contractors may have built confidence in the use of the mouse, and operating in a windows environment. However, the extent to which these skills will be useful to contractors in the future is uncertain.

The subversion of unplanned learning is a theme to emerge from the study that will be unpacked further in Chapter 8, Discussion and Conclusion.

7.6 Summary of findings

It is evident that, during the period of data collection, Apache Energy's goals of providing an efficient, effective and flexible mechanism to engage contractors in safety issues has been met. Further, the preceding three chapters suggest that most contractors responded well to the e-learning tool, particularly appreciating its self-paced attributes.

Chapter 5 presented the results of Phase 1 of the research by describing the design of the tool. It revealed that there were some ways in which the tool deviated from principles of effective learning, particularly in relation to in-built mechanisms for articulating goals, interacting with others and reflecting on the learning that had taken place. However, it seems that the learning objectives that targeted basic safety understandings did not require adherence to these principles.

Chapter 6 presented the results of Phase 2 of the study by describing the implementation of the e-learning tool. The data suggests a widespread acceptance of the self-paced learning attributes of the e-learning tool, but pointed towards some challenges:

- The social support for the tool is out of tune with its design in relation to articulating opportunities to integrate prior learning into the e-learning experience.
- Scaffolding options to help contractors who have difficulties in using computers to learn were absent in the implementation, but in some cases are required.
- Diagnostic attributes of the tool were not well explained to contractors and could be re-configured so that contractors leave the e-learning centre in a positive and reflective mindset.

Chapter 7 presented the results of Phase 3 of the research. It first articulated the achievement of desired outcomes from Apache Energy's perspective and then discussed unplanned learning outcomes to emerge. It is evident that the implementation of the e-learning tool went as Apache Energy would have expected. Desired outcomes – a cost efficient, effective and flexible e-learning tool – were attained, whereas unplanned learning outcomes, with the exception of some contractors enhancing their computer skills, seem to have been almost absent in the case study as far as the investigative techniques that were adopted could determine. That is not to say, however, that they did not occur.

Chapter 8 will now elaborate upon these themes in more detail.

CHAPTER 8
Discussion and Conclusion

8.1 Chapter overview

This chapter presents an interpretation of the findings that emerged from the study. Six key themes, arising from the implementation of the Apache e-learning tool, have emerged:

- Acceptance of the self-paced learning model.
- The value of tailoring.
- Absence of the social dimension to learning.
- The "compelling" nature of multimedia interactivity.
- Subversion of unplanned learning.
- Transparency of diagnostic processes.

The first theme is an umbrella concept that overarches all the other themes. An explanation of how the self-paced learning model affected and resonated with the various types of contractors that engaged with the e-learning tool is provided. This is done by examining four "typical" contractors in detail (fictitious names are used) including considering how these profiles relate to the study's theoretical framework.

All of the other themes have an applied focus, representing opportunities for improvement of the overall design and/or the implementation of the e-learning tool. However, they may also illuminate other corporate e-learning contexts. Again, these are unpacked by relating the theme to the various types of contractors that engaged with the e-learning tool.

The chapter closes with a conclusion that discusses some of the limitations of the study, and some possible avenues for further research.

8.2 Acceptance of the self-paced learning model

Self-paced learning emerged as the most significant positive aspect of Apache Energy's implementation of the e-learning tool. It was almost universally accepted as a unique and advantageous feature of the e-learning design. Throughout the interviewing process with contractors, and through the questionnaires, support of the self-paced attributes of the learning experience was repeatedly highlighted by a broad range of contractors.

This theme is consistent with the literature (e.g. Newton & Hase, 2002; Palmieri, 2003). However, the observation is somewhat at odds with the question of the readiness of some adult learners for self-directed learning (e.g. Smith, Wakefield, & Robertson, 2002). It should be noted, though, that there are differences between this research and the research conducted by Smith et al. (2002) which was targeted at VET apprentices and adopted a more general focus on flexible learning rather than e-learning. Contractors that engaged with the Apache Energy e-learning tool also did so for a much shorter period of time (typically half a day). It may be that contractors are an inherently different group of learners than, for example, employees and students. Their time is more likely to be measured in terms of dollars and cents and there may be a wide variation in contractor and employer attitudes towards long term professional and career goals. The scarcity of research into e-learning directed at contractors alluded to by Schofield (2003), along with the trend towards an increasingly contracted workforce suggests that the motivations, experiences and characteristics of contractors that engage in e-learning is worth considering in future research.

Another interesting observation that has come into focus as a result of overwhelming support of the self-paced learning model by contractors is where and how self-paced learning fits with the attributes of effective learning as described in Chapter 5. It could be argued that a control over the pace of learning is implicitly reflective and metacognitive. However, for the purposes of articulating clear guidelines for those

seeking to design and/or implement e-learning solutions in corporate contexts, it may be useful to be explicit about how to design for self-paced learning. This may call for a re-thinking of the attributes for effective learning in contracted or semi-contracted contexts. For example, for Apache Energy the principles of effective learning are probably more accurately expressed as:

- Learning is flexible in terms of both time and pace.
- Learning is authentic.
- Learning resources are visually motivating.
- Learning is interactive.
- Learning is reflective.

The experiences of contractors in the implementation of the Apache Energy e-learning tool, specifically as these relate to self-paced learning, are now discussed using Mayer's (2001) theory of multimedia learning and Valsiner's (1997) zone framework which were introduced in Chapter 3, Theoretical Framework. The following four typical contractors demonstrate how each individual's mix of experience in the resources sector, computer competency, motivation levels and attitudes to learning and safety, affected the way in which they responded to the self-paced learning design of the e-learning tool:

- Dave (I13) is a 35 year old electrician. He has 12 years experience in the resources sector and is highly competent in using a computer.
- Robert (I4) was introduced in Chapter 6. He is a mature man of 39 who has sought after skills as a boilermaker/welder. He has worked in the resources sector for nearly 20 years, and regards himself as a "computer illiterate".
- James (I3) was also introduced in Chapter 6. He is a young man of 26 who plans to work with Apache Energy as a trades assistant. He is inexperienced in the resources sector, but competent with computers.

- Gino (I7) is a 42 year old scaffolder. For most of his working life he has worked on construction projects in the Perth metropolitan area. He has no interest in, and has no cause to use, computers.

All contractors felt that safety was important, although to varying degrees. Dave and Robert showed a heightened safety ethic, perhaps because they had worked in the oil and gas sector for a number of years and the safety culture inherent in the industry had embedded itself into their respective psyches. James exhibited a particularly high level of motivation seeking to build a career for himself in the oil and gas industry.

8.2.1 Dave

Dave was impressed with the self-paced attributes of the e-learning tool. This was probably because it encouraged him to use his prior knowledge to fast track through the learning process. Although he noted the capacity of the tool to refresh his memory on some safety issues, for him, there was not a lot of new information in the e-learning tool. Figure 8.1 shows how Dave responded to the environment that was presented to him at the e-learning centre.

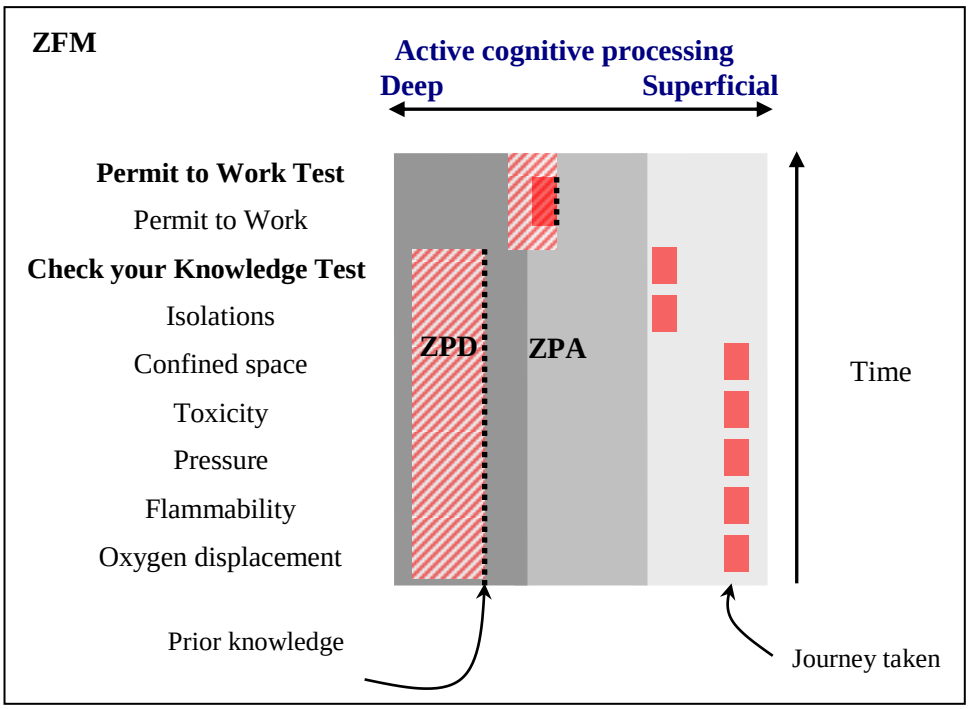


Figure 8.1. **Dave's experience in engaging with the Apache Energy e-learning tool expressed through Mayer's theory of multimedia learning and Valsiner's zone framework.**

The Zone of Free Movement (ZFM) observed by Dave as he enters the e-learning centre comprises the computers, networks, software and administrative support. As he is introduced to the e-learning centre and acquaints himself with the environment, he is aware of certain actions that are promoted (ZPA):

i. That he is expected to go through the process and pass the induction.

ii. That the tool is self-paced and it appears to be well put together.

iii. Apache Energy seems to value safety.

All of these promoted actions concur with his own safety ethic, and his level of computer competency. Dave already knows a lot about safety having worked in the oil and gas industry for some years. His possibilities for development (his ZPD) are not particularly aroused because he perceives that he will not learn anything new. This is confirmed to him as he works through the Introduction to Oil and Gas segments of the e-learning tool. However, going through these segments reinforces some of his existing safety understandings.

Passing the Check your Knowledge and Permit to Work tests is important to Dave and his level of engagement improves as he moves in to the Check your Knowledge test. His interest further increases (and ZPD is stimulated) as he engages with the Permit to Work components of the e-learning tool and the Permit to Work test (the Permit to Work system at Apache Energy is slightly different to the systems that he has encountered at other oil and gas facilities). It is possible that his level of active cognitive processing also increased during the Permit to Work segments of the e-learning tool. Dave passed both tests.

The data suggests that Dave's cognitive capacity in his working memory was not particularly stressed, although the Permit to Work aspects of the e-learning tool were slightly more challenging than any other aspect.

All in all, Dave was pleased with the self-paced attributes of the e-learning tool, although he has worked through most aspects of the tool in a step-by-step manner,

skipping what he felt was unimportant. The dual channel features of the tool enabled him to move through at a rapid pace. He believes that his time was spent wisely, having passed both tests in just over two hours. Because of his well developed computer skills, the level of intervention from the administrator of the e-learning centre was minimal. He was not particularly challenged by the tool, though, having interacted with it on a fairly superficial level.

The tool did not promote communication with others and there was no time for reflection as his focus was on getting through the process quickly. A consideration of the knowledge embedded in the e-learning tool in the context of his on site activities, is something that may occur when he reaches the site. At the point of leaving the e-learning centre, therefore, Dave did not appear to engage in any learning that was outside of the scope of the e-learning tool (i.e. unplanned learning), and the learning that he did immerse himself in, was largely a reinforcement of current understandings.

To draw an analogy for Dave's e-learning experience, he was driving a powerful and reliable vehicle in the fast lane of the freeway. He took little notice of the landscape around him, being more focused on reaching his destination. He did not stop or reflect on the journey, and reached his destination quickly. He was satisfied with the journey because it was done in record time.

8.2.2 Robert

The e-learning experience worried Robert. It highlighted his lack of computer competency, and he felt that not passing the tests would reflect badly on him. As with Dave, Robert noted the capacity of the tool to refresh his memory on some safety issues, but felt that there was not a lot of new information in the e-learning tool.

One exception to this was the confined space aspect of the tool. Although Robert has worked in confined space environments before, he had never been actually responsible for ensuring that the workplace is safely prepared and maintained for a confined space entry. Robert acknowledged that going through the e-learning process

at his own pace was more time-efficient than attending a face-to-face induction, but admitted that computers frustrated him. Figure 8.2 shows how Robert responded to the environment that was presented to him at the e-learning centre.

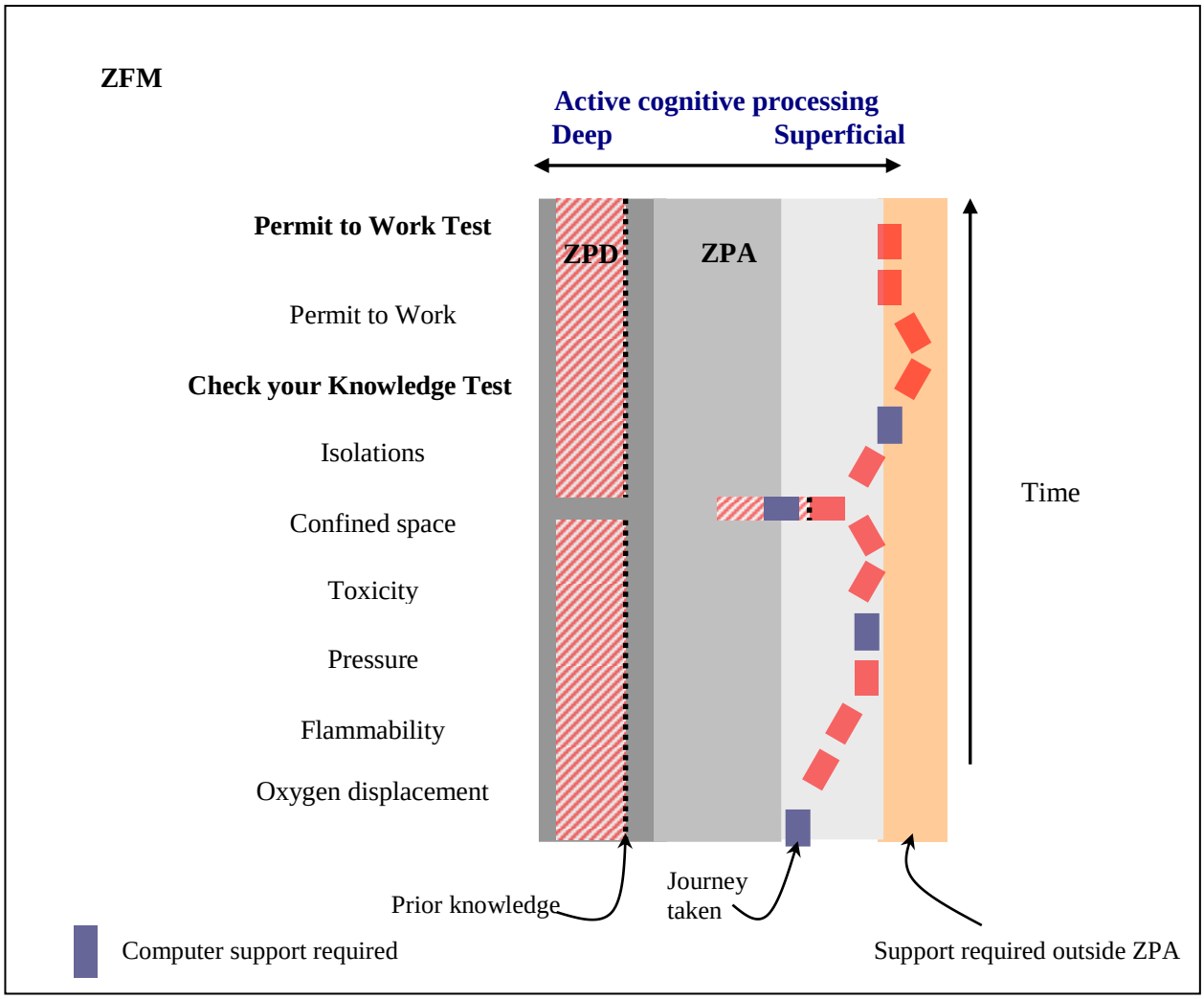


Figure 8.2. **Robert's experience in engaging with the Apache Energy e-learning tool expressed through Mayer's theory of multimedia learning and Valsiner's zone framework.**

It is evident from Robert's experiences in interacting with the e-learning tool that he spent a good deal of his time striving to align his actions with those promoted by Apache Energy (i.e. the ZPA). His lack of computer skills repeatedly forced him off task and requiring support. This suggests that grappling with computer competencies dominated his cognitive capacity. The absence of immediate help caused him some

frustration. The support that was provided tended to focus on "getting through" the content and attempting the tests. Robert did not *learn* from instances that required intervention and each instance seemed to cause him to become more disengaged with the e-learning experience.

With the exception of the confined space component, his level of engagement with the e-learning tool was marginal because most of his cognitive load was devoted to understanding how to use the computer. In this respect, there were benefits of using the tool in terms of unplanned learning, but the application of any new skills will depend on the extent to which Robert uses computers in the future.

With regard to engaging with the confined space component of the e-learning tool, Robert required some support (which he did not actually receive) in order for this to become a meaningful learning experience (i.e. stimulate a deeper level of active cognitive processing). He eventually gave up and focused on simply passing the tests.

There were times when Robert required support that was outside of the ZPA. For example, at one point he wanted to discuss some issues with respect to his Check your Knowledge test and later he sought some clarification from the e-learning centre administrator on a hazard identification issue in the Permit to Work segment. However, there was no one available with the appropriate level of safety knowledge so his needs were left unmet.

Despite the difficulties that Robert encountered, he is still attracted to the self-paced aspects of the e-learning experience because he sees that it has potential in saving time and energy in future inductions. His e-learning experience lasted three hours, and could have lasted more had he not become frustrated with the computer. He believes it is the way of the future and is determined to learn more about computers so that he is not placed in this position again. He did not learn anything new as far as his safety knowledge is concerned, and in fact felt that his scores in the tests did not do his knowledge levels justice. However, he increased his skills in using computers (particularly working in Windows and using a mouse) to the extent that he feels that if he went through the process again, he would do much better.

To draw an analogy for Robert's e-learning experience, he was driving an unreliable vehicle in the fast lane of the freeway. He tried to navigate in a purposeful manner but tended to meander. He broke down a couple of times and a mechanic quickly got him back on the road again, but gave him no directions. He took little notice of the landscape around him except to worry about the vehicle, being more focused on keeping his vehicle on the road. He did not stop or reflect on the journey, and reached his destination with much relief.

8.2.3 James

James felt that the e-learning experience was worthwhile. On entering the e-learning facility he had little knowledge of safety issues that were pertinent to an oil and gas facility. Now he feels confident of his understandings and is looking forward to going on site. Figure 8.3 shows how James responded to the environment that was presented to him at the e-learning centre.

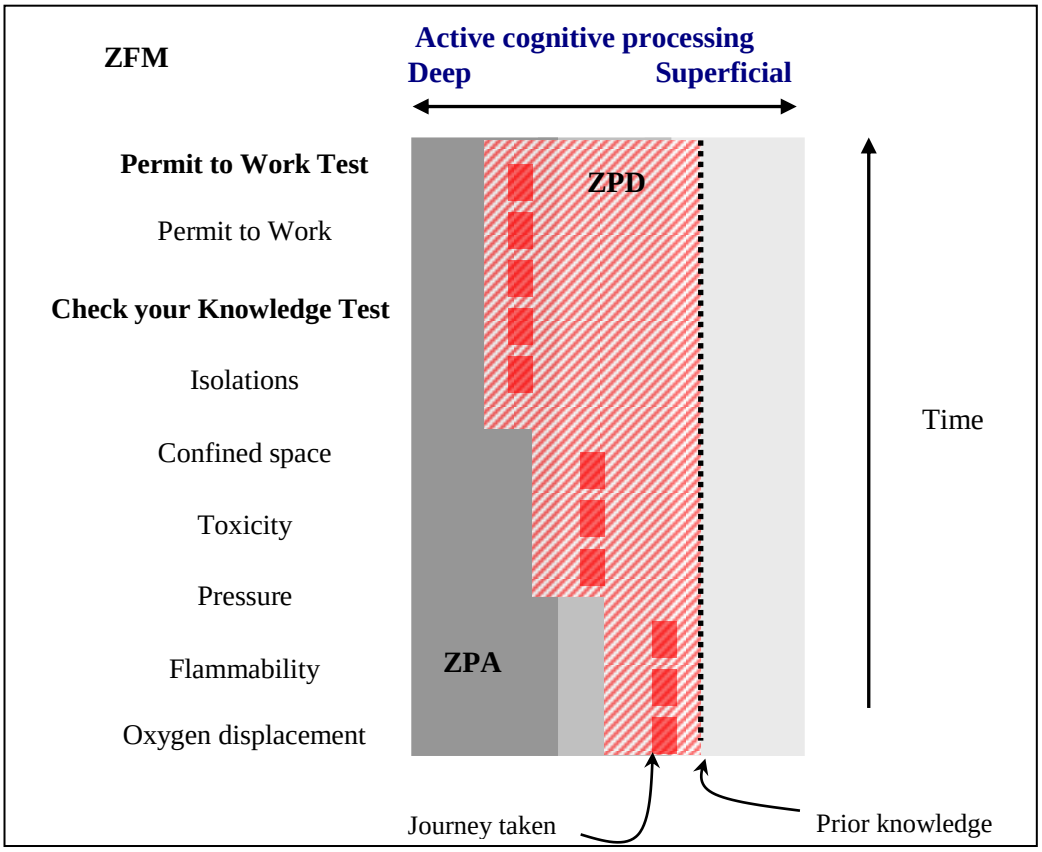


Figure 8.3 James' experience in engaging with the Apache Energy e-learning tool expressed through Mayer's theory of multimedia learning and Valsiner's zone framework.

James appreciated the self-paced aspects of the e-learning tool, particularly in being able to go over interactive elements more than once to satisfy himself that he was sure of the safety concepts that were being presented. At the time of interacting with the Apache Energy e-learning tool, James knew very little about safety in the oil and gas industry. His possibilities for development (his ZPD) were high because he perceived that he would learn something new, and he was motivated to make a good impression with Apache Energy. He started cautiously, but as time passed and he became familiar with the learning environment, he began to derive greater benefit. James spent four hours interacting with the e-learning tool.

Passing the Check your Knowledge and Permit to Work tests was important to James and his levels of engagement increased as he engaged with the Check your Knowledge test. He passed both tests.

James was satisfied with the e-learning experience. He felt that his level of knowledge about safety has increased significantly as a result of engaging with the e-learning tool. This may indicate deeper levels of active cognitive processing.

Because of his well developed computer skills, the level of intervention from the administrator of the e-learning centre was minimal. The tool did not promote communication with others, but James was not concerned with this. He felt that there would be plenty of time for interaction on site.

From time to time during the e-learning experience, James seemed to re-assess his safety knowledge in the light of what he was learning about the oil and gas sector. At the point of leaving the e-learning centre, however, it is difficult to gauge whether James engaged in any learning that was beyond the scope of the e-learning design.

To extend the analogy for James' e-learning experience, he was driving a powerful and reliable vehicle in the slow lane of the freeway. He paid a lot of attention to the landscape around him, and stopped frequently to consider the landscape and reflect on the journey. He reached his destination having enjoyed the trip.

8.2.4 Gino

Gino works in the building industry in metropolitan Perth as a scaffolder. He is interested in working in the oil and gas industry in the North West Shelf because of perceived economic benefits of such a career move. He has little knowledge of safety in oil and gas environments and seldom uses a computer.

Gino was disappointed with the learning environment presented to him when he arrived at the e-learning centre, but didn't want to "rock the boat" and decided to give it a go. Figure 8.4 shows how Gino responded to the learning environment that was presented to him at the e-learning centre.

Gino has poor computer skills and also little experience in the resources sector, and he struggled throughout the e-learning experience. Although he was physically located in the e-learning centre, he didn't feel like he really belonged there and constantly relied upon support. However, he did accept the learning design, probably believing that e-learning was the way in which safety training was conducted in the resources sector generally.

Gino spent just under three hours engaging with the tool, essentially giving up because of frustration with using the computers. He did not pass either of the tests.

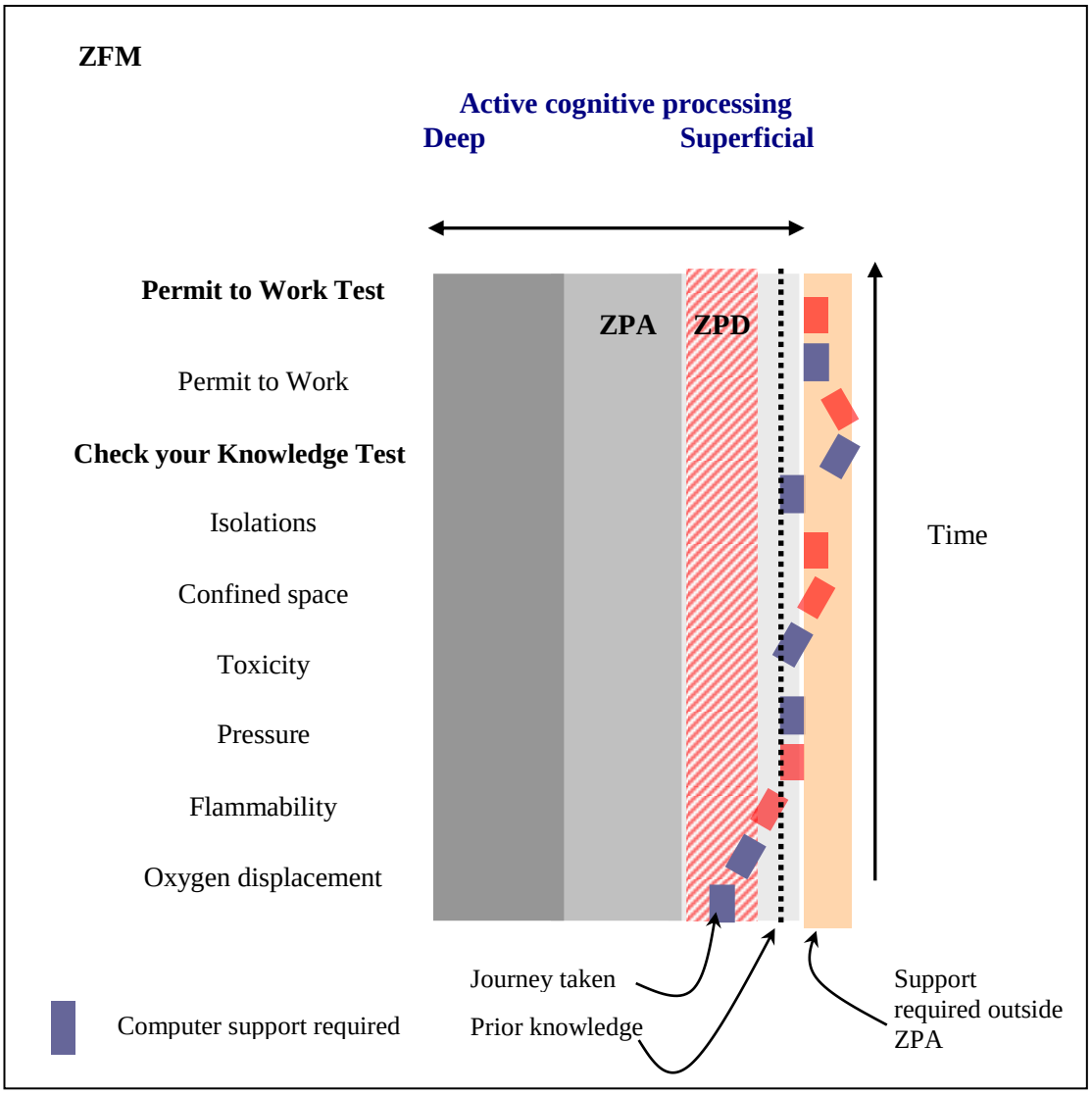


Figure 8.4. **Gino's experience in engaging with the Apache Energy e-learning tool expressed through Mayer's theory of multimedia learning and Valsiner's zone framework.**

A thorough introduction would have helped Gino, along with immediate and anticipatory computer skills support covering aspects such as how to use a mouse and how to open and close Windows. It is doubtful whether Gino learnt much at all from the e-learning experience. It is probable that most of his cognitive resources were allocated to understanding the computer and software environment. As time went on he began to rely more and more on the administrator of the e-learning centre for assistance. When she was unavailable, he asked others in the e-learning centre for assistance and was not adverse to venting his frustration audibly which distracted others in the e-learning centre.

The gap between Gino's prior knowledge and his ZPD is symptomatic that some form of scaffolding was required. The administrator of the e-learning centre herself became frustrated with Gino's efforts and began to perceive that the support required of her was outside of the scope of her duties (i.e. ZPA).

Like Robert, Gino's e-learning experience was like driving an unreliable vehicle in the fast lane of the freeway. He tried to navigate in a purposeful manner but was not successful. Other road users were irritated by Gino's meandering pathway. He repeatedly broke down and a mechanic got him back on the road again, but did not fix the underlying problem and gave him no directions. He took little notice of the landscape around him, being more focused on keeping his vehicle on the road. He did not stop or reflect on the journey, and on reaching his destination abandoned the vehicle.

In considering how Dave, Robert, James and Gino responded to the self-paced attributes of the e-learning tool, some clear profiles emerged. As would be expected, those with well developed computer skills with little knowledge of safety in the resources sector (e.g. James) derived a *learning* benefit from the tool. The self-paced attributes of the tool were realised by engaging with media as many times as was necessary. This group of contractors typically scored well in both of the tests, however, it is unclear whether any unplanned learning occurred.

Contractors with well developed computer skills and significant prior knowledge of safety in the resources sector (e.g. Dave) derived a *pragmatic* benefit from the tool. The self-paced attributes of the tool were realised by fast-tracking through the e-learning experience. However, it is unlikely that any unplanned learning occurred as contractors from this group were more concerned with completing the process in a timely manner.

Contractors with little or no computer skills and significant knowledge of safety in the resources sector (e.g. Robert) derived *partially pragmatic* benefits from the tool. The self-paced attributes of the tool were realised by getting through the e-learning experience at a rate that was quicker than a face-to-face alternative. However, lack of computer skills inhibited the achievement of this in an efficient manner. It is possible

that unplanned learning occurred in the area of computer skills development for this group of contractors.

Contractors with little or no computer skills and limited knowledge of safety in the resources sector (e.g. Gino) derived *limited benefit* from the tool. The self-paced attributes of the tool were not appreciated. A facilitated group environment would probably have suited this type of contractor better. It is unlikely that any unplanned learning emerged as most of the time contractors from this group were concerned with mastering the computer software and comprehending basic safety understandings.

An over-riding sentiment amongst contractors was that e-learning was "the way of the future", and if it was Apache Energy's way of doing things, then it was better to fit in and "give it a go" rather than resist. Despite the positive response to the self-paced attributes of the tool, it should be noted that the flexible design was not well explained to contractors, and not used to its full potential. For example, at no time during the researcher's observations were contractors asked about their prior knowledge and advised that going straight to the tests was an appropriate way to use the tool.

It should be stressed that the four categories of contractors that Dave, Gino, James and Robert represent are not intended to be precise depictions. Computer literacy and safety knowledge are best viewed as elements of a continuum rather than measurable absolutes. However, Mayer's theory of multimedia learning and Valsiner's zone concepts have provided a useful interpretive tool in which to consider the experiences and behaviours of contractors in a resource based e-learning environment.

8.3 The value of tailoring

Providing learners with the best possible learning opportunities is one of the great challenges for educators (Smart, 2002).

In the context of Apache Energy, tailoring the e-learning tool to best meet the needs of individual contractors has at least two dimensions: recognition of prior knowledge and appropriate intervention.

8.3.1 Recognition of prior knowledge

There are clearly tensions between the intended design of the e-learning tool and its implementation. One of the main sources of friction is in how prior knowledge is dealt with.

At Apache Energy, a good deal of thought went into the design of the e-learning tool so that contractors could use it to meet their requirements. The most critical component of this design is the acknowledgement that contractors come to the e-learning centre with a range of prior safety understandings. The tool is designed so that contractors can self-select content appropriate to them, and take the tests when *they* are ready. However, the design assumes that contractors are provided with some form of introductory material to facilitate a basic understanding of the design.

A flow chart (Appendix F) was provided to each contractor when they arrived at the e-learning centre. Although this flow chart is well set out, many contractors clearly found it difficult to interpret. The e-learning tool was designed to be non-linear, with multiple entry and exit points so that contractors had some choice in matching the content of the tool with their prior understandings. As one option, contractors could work through the content from start to finish. Another option enabled contractors with prior knowledge to approach the e-learning tool in a different way (e.g. go immediately to the tests). However, the messages that contractors received from the administrator of the e-learning centre (e.g. you need to work your way through all of the content and *then* take the tests) contradicts the information provided on the flow chart.

The implementation practices at the e-leaning centre tended to treat all contractors in the same way in that they were expected to engage with the e-learning tool from start to finish. This was probably related to how administrative staff at the e-learning centre gauged effective e-learning (linear and structured). In observing how

contractors interacted with the tool, it is clear that the non-linear features of the tool were not introduced. This meant that contractors had a perception they were required to work through the tool in a linear fashion, and although some worked out for themselves that this was not the case, it represents a lost opportunity in terms of a more effective e-learning implementation.

An area for improvement is to better align the way in which the e-learning tool is presented to contractors with its design features. An introduction that is configured towards helping contractors to tailor their interaction with the tool to best fit *their* needs would be useful. This would help experienced contractors to be more strategic in their approach, and also serve to soften the impact of the ICT environment for contractors with limited experience in using computers and/or who have low literacy skills. Another option may be to design an up-front self-assessment instrument that may help contractors to choose how best to interact with the tool.

8.3.2 Appropriate intervention

Facilitation – or appropriate intervention – was also a point of friction between the design of the tool and its implementation. The tension between productivity and more liberal notions of learning alluded to in Chapters 1 and 2 (Ainsworth, 2000; Davies, 2002; Harris & Volet, 1996) was played out in the dilemma of if/when/how to support learning at the e-learning centre.

Effective learning design recognises the importance of learner support mechanisms, and of providing scaffolding processes to assist learners to engage more actively with e-learning materials (e.g. Oliver, 2001). The Apache Energy e-learning tool was designed as a component of an overall implementation strategy, recognising that some contractors, particularly those with limited computer skills, may need help. One way in which the learning experience can be tailored for contractors is to observe the way in which they are interacting with the tool to determine if any support is required.

However, this approach was not seen as the mandate of e-learning centre staff. Locating the support function outside of the e-learning centre put distance between

the contractor and the support function. So instead of anticipating critical moments in the learning process, support staff responded to situations after contractors had exhausted sometimes unfruitful avenues in which to solve their own problems. Worse still, sometimes contractors "gave up" rather than contact the e-learning centre administrative staff and just moved on. In this respect, opportunities for learning were lost.

Support staff at the e-learning centre perhaps had a perception that the software had a greater capacity to support contractors than it actually had. Or it may be that because staff at the e-learning centre were more familiar with e-learning tools with a linear design, that they did not anticipate the level of support required in the Apache Energy e-learning tool. Whatever the case, the level of support that was offered, particularly to those contractors with limited computer skills, was generally deficient.

Contractors new to the resources sector generally were more inclined to work through the e-learning tool rigorously, and depending on their computer and other literacy proficiencies, required more support. For this group, many opportunities for intervention would have been clearly evident for the skilled facilitator.

It should be acknowledged that Apache Energy targeted the e-learning tool at ensuring that contractors were able to achieve and demonstrate basic safety understandings, and skilled intervention to promote deeper learning opportunities was not part of its agenda. In saying this, the provision of an introduction that was cognisant of the learning design and the removal of the unnecessary distance between the contractor and the administrative/technical support function would have further improved the quality of learning outcomes with minimal effort.

8.4 Absence of the social dimension to learning

In developing the e-learning tool, Apache Energy took a position that adopting learning strategies to encourage social interaction, other than a brief technical introduction and an on-site verification of competency, were superfluous for the needs of most contractors. For more complex learning situations that require higher levels of abstraction, the organisation supports and facilitates hands-on professional

development activities, group work, and even online interaction. However, in relation to basic safety understandings aimed at contractors, who potentially may only work with Apache Energy for a brief period of time, the e-learning design and its implementation largely ignored the social dimension to learning.

This approach to the design of the e-learning tool is consistent with Jonassen and Tessmer's (1996) taxonomy which links instructional strategies with learning outcomes. However, although Apache Energy's approach ensures that learning solutions are relevant and focused to the requirements of both the company and the contractors working with the company, it is evident that the approach imposes boundaries around the learning process. For instance, there are limited opportunities for:

- Unplanned learning that may be stimulated by informal social interaction.
- Deeper levels of engagement with activities and content through problem solving, research and/or discussion.

It is clear that an instructional model that was devoid of social interaction was appropriate for most contractors that engaged with the Apache Energy e-learning tool. Further, most contractors supported this model. This observation is in harmony with the literature on the role of constructivism to e-learning in training contexts. For example, Wonacott (2002, p. 2) in his work on the role of constructivism in web based training states:

> The built-in potential and capabilities of WBT [web based training] for constructivism are not always appropriate for every learning task. Sometimes it may be more appropriate to transmit knowledge than to have learners construct meaning.

It was evident from observation, that most incidences of interaction between contractors came when one or more contractors were having problems, and they attempted to solve these problems by helping each other. However, there was very little interaction unless the contractors knew each other personally, and in most instances, this was not the case.

When asked about levels of interactivity with fellow contractors, responses were generally towards the negative. There was a view that this was frivolous and contra to the self-paced design of the e-learning tool. Contractors, certainly those with well developed computer skills and experience in the oil and gas industry, did not seek the company of others. As discussed the primary focus was to fast track their way through the e-learning tool.

For contractors who were not experienced in the oil and gas industry and had less well developed safety understandings, attitudes towards the provision of opportunities for discussion and social interaction were variable. Contractors with less developed computer skills, but were experienced in working in the resources sector could have done with some support at various stages of the process to enhance their confidence, but even this group generally was keen on working independently. Contractors with less developed computer skills, and little experience in working in the resources sector probably would have responded better to a learning model that encouraged sharing of understandings and formal and informal communication and collaboration opportunities to promote learning.

8.5 The "compelling" nature of multimedia interactivity

When asked about the attributes of e-learning compared to traditional face to face inductions, most contractors acknowledged that e-learning was a more appropriate learning strategy. As discussed, the self-paced design of the e-learning tool was almost universally accepted. However, interestingly, contractors acknowledged that they learnt *more* by engaging with the e-learning tool simply because they had to. In the e-learning centre they were "forced" to interact with the tool; whereas in a traditional classroom based environment they could switch off. Thus the tool ensured that contractors took responsibility for their own learning.

This perhaps negative connotation of the term "compelling" was augmented by some positive responses to the authentic and interactive components of the tool that engaged contractors. The responses of contractors to the use of multiple forms of media in the e-learning tool were consistent with other research that has been

conducted into the benefits of multimedia learning (e.g. Mayer, 2001; Mayer, Dow, & Mayer, 2003).

For some contractors who were experienced in working in the resources sector, the interactive features of the e-learning tool (e.g. formative quizzes, simulations, crossword puzzle etc) may have been seen as a little over elaborate. Tasks like exploring ignition sources in flammable and non-flammable environments may not have been viewed as particularly challenging by this group, and may even have been slightly irritating particularly to those with limited computer skills. As previously discussed, a tailored introduction to the e-learning tool for this type of contractor would no doubt have promoted a more self-selecting approach as was intended by the design.

For those who were not experienced in working in the resources sector, however, the evidence suggests that the interactive elements of the e-learning tool may have stimulated greater levels of engagement, particularly for those who had well developed computer skills. The use of graphical, textual and audio media to mediate authentic activities may well have contributed to understandings that persisted into the workplace. Observation, qualitative feedback through interviews and relatively high results in both Check your Knowledge and Permit to Work tests indicate that this may have been the case.

The administrator of the e-learning centre did not champion the formative learning elements of the e-learning tool, the implication being that these replicated the summative learning elements of the tests. Some contractors interpreted that these formative components were not necessary, and flipped through them quickly focusing on the tests. In this way, it is probable that learning opportunities were lost in the translation. Had formative and summative components of the tool been introduced with equal enthusiasm, then contractors may have derived more benefit from both features of the tool.

8.6 Subversion of unplanned learning

In the case of the implementation of the Apache Energy e-learning tool, the researcher targeted two areas of possible unplanned learning:

i. Learning that occurred in the area of safety at a level deeper than that which was intended.

ii. Learning that occurred outside of the area of safety. This can involve generic skills and competencies such as communication abilities and teamwork skills, but also specific skills development like computer proficiency.

Data from observation and interviewing suggests that both of the above were subverted by one or more of the following:

- The design of the tool.
- The independent nature of e-learning experience.
- The context in which contractors were operating.

8.6.1 The design of the tool

As discussed in Chapter 3, Theoretical Framework, the Apache Energy e-learning tool was designed primarily to develop basic safety understandings amongst a contracted workforce. This did not preclude contractors from considering the information contained in the e-learning tool on deeper levels (e.g. *thinking* about applying information about the weight of natural gas to other real world work situations). However, the tests were squarely aimed at information retention rather than knowledge construction and this, coupled with an inability to set individual goals in relation to the learning experience and the way in which the tool was presented to contractors, tended to limit the efficacy of the formative learning content contained in the tool. Further, the focus of the tool on information provision meant that it did not promote the development of any generic skills like enhanced communication capabilities, problem-solving or team skills. If in future the tool is

used in ways to promote group work or is further developed to pose ill-defined problems to contractors, then this may promote deeper thinking about safety issues. These remain options for further improvement should Apache Energy see this as a worthwhile investment.

The design of the tool assumed that contractors would have basic computer skills, and those that did not, were required to quickly develop competency. For experienced users of computers, the e-learning tool would have posed no challenges and it is doubtful that they would have learnt anything new. For inexperienced users of computers though, the use of a mouse to engage with drag and drop simulations or the act of using multiple windows to view a text transcription of an audio, were usually problematic. With good technical support and practice, skills in these areas would have no doubt improved. However, many contractors who were not proficient in using computers had no intention of using them on a regular basis as a result of engaging with the e-learning tool, so the value of improving computer skills may have been negligible.

8.6.2 The independent nature of the e-learning experience

Unplanned learning can sometimes emanate from listening to others, and contributing to formal and informal discussions (Zenger & Uehlein, 2001). However, the e-learning tool provided limited opportunities for contractors to communicate either between themselves or with a knowledgeable facilitator, although this may have occurred on site. The self-paced, independent nature of the e-learning tool, which was so supported by most contractors, actively militated against any deeper learning that may have ensued from formal and informal collaboration amongst contractors at the e-learning centre.

In saying this, having mastered the navigation aspects of the design, there may have been some improvement in the confidence and self-efficacy of contractors in approaching self-paced e-learning designs in the future.

8.6.3 The context in which contractors were operating

The time constraints placed on many contractors that attended the e-learning centre were such that exploration and deeper thinking about safety issues generally did not happen. Contractors indicated an interest in the "real world" component of the e-learning tool which sought to provide examples of authentic situations where safety issues were played out (e.g. accidents). However, this interest waned with the realisation that these components were not assessed. As with other formative components of the tool, the e-learning centre administrator tended to be unenthusiastic about their value.

Overall, it is difficult to gauge the extent of unplanned learning that occurred through engaging with the e-learning tool. Although the research design allowed for qualitative attempts to tease out issues of unplanned learning through interviewing and observation, an approach that involved detailed measurement of knowledge transfer may have been more appropriate for the study. This is discussed below in 8.9, Other limitations.

8.7 Transparency of diagnostic processes

According to safety advisers, most contractors found the on site verification of safety understandings gleaned from the off site e-learning experience to be appropriate. Those who had passed the tests went through the process seamlessly. For those contractors that had not, with the help of the safety adviser, they were able to de-construct their understandings of workplace safety issues to develop a clearer and more appropriate knowledge-base, certainly from the perspective of Apache Energy. Thus the assessment approach evident at the e-learning centre (for information retention) is supplemented by on-site support that ensures that contractors are equipped with appropriate safety knowledge to conduct work on-site.

However, on leaving the e-learning centre, some contractors were unsure of where they went wrong in the tests. This was particularly pertinent to those contractors that had failed the tests, who, on leaving did not know which questions they had failed and why. One solution to this situation may be to provide contractors with answers to

the tests, along with brief descriptions of why the answers are correct. In this way at least contractors will leave the e-learning centre with an opportunity to engage in further learning before they attend site.

The rationale for the diagnostic process was not clear to contractors. On attending the e-learning centre many contractors believed that the e-learning experience involved summative testing for the specific purpose of precluding the contractor from attending site if they failed. Instead, Apache Energy sees the e-learning tool as a formative and diagnostic process: essentially identifying areas in which the safety adviser can focus on, once the contractor has reached site. It may be useful to ensure that the diagnostic functions of the tool are made clear to contractors as part of the e-learning introduction.

8.8 Limitations of the research

Three types of constraints impacted upon the research. These were resource constraints, contractor time and communications constraints, and research time constraints.

8.8.1 Resource constraints

Apache Energy operates its oil and gas facilities in the North West Shelf of Western Australia some 1,300 kilometres from metropolitan Perth. Although it would have been useful to attend one or both of the facilities to track contractors as they went through the diagnostic process with safety advisers, and perhaps interview them to gauge the relevance of the e-learning experience to their work roles, this was not possible because of the significant costs involved.

It would have also been useful to interview supervisors to gauge the impact of the e-learning tool from a supervisory perspective. However, at the time of the research the implementation of the e-learning tool was embryonic.

8.8.2 Contractor time and communications constraints

Contractors tended to fit the e-learning experience in with their other priorities. Some contractors were rushing to other jobs, and were visibly agitated when the researcher requested an interview. Although no contractor refused to be interviewed, there were clearly time pressures on the interview process both in terms of the number of questions that could be posed and the depth in which these could be followed up.

Whilst contractors were on site, channels of communication were limited. Both Apache Energy sites are out of mobile phone range and there is one telephone for private use at each site, usually heavily used. Contractors had no access to the Apache Energy email system and there was no access to other Internet facilities (e.g. Webmail) on either of the sites.

Most contractors were involved with multiple companies, working on a variety of on- and off-site shift arrangements, and contacting contractors after they had attended the Apache Energy oil and gas facility was not only difficult, but again impinged upon their time.

All of these factors meant that it was difficult to communicate with contractors once they had left the e-learning centre.

8.8.3 Research time constraints

The data collection phase of the research was conducted over an eight month period between May and December 2005. This was early in the implementation process, and it may have been useful to extend the data collection phases of research possibly over two or three years. There are at least two benefits to this approach. First, the research would have generated a longitudinal dimension that would have provided a greater level of reliability to its findings. Second, opportunities for action research would have emerged with the research being able to assess the quality and value of improvements made to the e-learning tool and its implementation. Notwithstanding these benefits, the study was Masters level research, and as such the time that the researcher could spend on data collection was limited.

8.9 Other limitations

In addition to the above constraints, a number of other issues imposed limitations on the research. First, the research is set in the oil and gas industry. It is acknowledged that this level of specificity limits the extent to which inferences can be drawn and applied to other industries and education sectors. Second, the study was conducted by one researcher, and although this has benefits in terms of the consistency of data preparation and identification, it is acknowledged that it has the potential to limit interpretation, although peer de-briefing significantly reduced this risk.

8.10 Suggestions for further research

The theoretical framework used in this study blended a cognitive theory of multimedia with a socio-cultural theory using zone models. The application of this theoretical framework to other corporate education and training contexts may provide a fruitful avenue for further research.

A longitudinal study of the implementation of the Apache Energy e-learning tool would also be valuable, bringing in time series data on safety incidents/accidents as well as a greater depth of qualitative data involving more contractors, supervisors, contracting agencies and management.

Finally, research into the costs and benefits of unplanned learning, possibly using alternative data collection methods like transfer tests, to gauge the extent to which knowledge transfer took place, may prove to be useful.

8.11 Conclusions

Overall, there was a good deal of support for the way in which the Apache e-learning safety tool was implemented. Contractors generally exhibited high levels of motivation to learn something from the experience.

This research suggests that Apache Energy has adopted an appropriate implementation approach for an e-learning tool targeted at uncomplicated

understandings in the area of site safety. This approach questioned collaboration between contractors as a critical aspect of the implementation strategy, and advocates that a self-paced, resource-rich e-learning environment is most beneficial to the target audience. In critically appraising the value of collaboration between contractors in this industry context, the study is suggesting an approach to the design and implementation of e-learning that is based upon determining an appropriate mix of effective learning attributes. The attributes should be grounded in a solid understanding of the relationship between three elements:

- Learning theory.
- Target audience.
- The education and/or training need.

It has been shown that the decision not to facilitate groups of inductees or to explicitly encourage interaction amongst contractors has attracted support from safety personnel at Apache Energy and also by contractors themselves, who are operating in time-scarce environments, and who are required to attend many safety inductions as part of their role as contractors. However, the on-site component of the safety induction has advantages both for staff at Apache Energy (for verification of competency), and for the contractors themselves who are provided with opportunities for their learning to be acknowledged and affirmed.

The issue of conflict between productivity and learning objectives, alluded to earlier in the study (e.g. Harris & Volet, 1996), only manifested itself partially, possibly due to the widespread acceptance of the self-paced learning design. Apache Energy did not place time constraints on engaging with the e-learning tool. If there were conflicts between learning and productivity, then this was an issue that contractors resolved within the context of their own work priorities.

One of the initial concerns of Apache Energy was that contractors would not have the necessary levels of self-directedness to engage with the tool in a meaningful way. This was a valid concern and one which is supported by research into flexible

learning in competency-based settings (e.g. Smith, 2001). The Apache Energy e-learning tool, however, has not proven to have posed an engagement problem for most contractors. This may be because contractors are only required to interact with the e-learning tool for a relatively short period of time (4 to 6 hours), and most contractors felt motivated by the content and the attributes of the tool, and their ability to control the pace of their learning.

The e-learning tool is clearly not for everyone. There is a concern that the level of facilitation provided does not meet with the expectations of some contractors, particularly those with limited literacy and computer skills. Although the tool sought to be literacy friendly and contained a good deal of audio media content to complement textual material, those with limited experience with computers found it time consuming to get acquainted with the navigation of the tool and build confidence.

There are tensions between the intended design and its implementation, and this is certainly evident in the way in which the tool has been developed to cater for prior competency (e.g. non-linear with multiple entry and exit points), and the perceptions of administrative/technical support staff about what constitutes good practice e-learning (linear and structured). In observing how contractors interacted with the tool, it is clear that the non-linear features of the tool are not introduced. One area for improvement in the implementation is to provide an introduction to the e-learning tool that highlights its design features. This would help the experienced contractors to be more strategic in their approach and also serve to soften the impact of the ICT environment for contractors with limited experience in using computers. Another option could be to design an up-front self-assessment instrument that may help contractors to choose how best to interact with the tool.

Contractors were generally supportive of the flexible nature of the e-learning tool in terms of their ability to choose a time that was appropriate for them. Some went further and queried why the tool was not provided online, affording increased opportunities for access anytime, anyplace.

In terms of the learning that has emerged from engaging with the e-learning tool, the majority of contractors found it compelling, and the results of both Check your Knowledge and Permit to Work tests confirm that contractors came away from the e-learning experience being able to demonstrate an understanding of the required levels of information. In relation to unplanned learning, the results are less clear. Contractors with well developed safety understandings are unlikely to have engaged in deeper levels of knowledge construction. For them, the benefits of the tool are about achieving a rapid outcome. Contractors with rudimentary safety understandings may have learnt in greater depth than would have been the case in traditional face-to-face inductions. However, this probably depended on their ICT competency. Some contractors may have developed their computer skills and/or increased their confidence in using computers, but the value of this outcome depends on the extent to which they might use computers in the future.

This research is intended to provoke thought about the circumstances under which e-learning can be effectively implemented in corporate contexts. Contractors that work in the oil and gas industry come from a variety of backgrounds and exhibit a range of prior experiences, knowledge and skills as well as learning styles and preferences. However it is clear that for many, well designed, self-paced activities and resources that are sensitive to prior knowledge and can be validated on-site are fit for the purpose of providing an effective safety induction in the oil and gas industry.

REFERENCES

Ainsworth, D. (2000). The unbearable cost of interaction. Retrieved February 12, 2006, from http://www.unisanet.unisa.edu.au/cccc/papers/refereed/paper2/paper2-1.htm

Aleven, V., Stahl, E., Schworm, S., Fischer, F., & Wallace, R. (2003). Help seeking and help design in interactive learning environments. *Review of Educational Research, 73*(3), 277-320.

ASTD, & NGA. (2001). *A vision of e-learning for America's workforce*. Alexandria, Virg: American Society for Training and Development (ASTD) and National Governors Association (NGA).

ASTD, & The MASIE Center. (2001). E-Learning: "If we build it, will they come?" Retrieved January 28, 2006, from http://www.masie.com/masie/researchreports/ASTD_Exec_Summ.pdf

Australian Flexible Learning Framework. (2004). Desired characteristics of Toolbox learning materials. Retrieved November 3, 2004, 2005, from http://www.flexiblelearning.net.au/toolbox/documents/docs/characteristics.doc

Australian Flexible Learning Framework. (2005). *Practical guide to e-learning for industry*. Canberra: AFL Framework.

Bate, F., Robertson, I., & Smart, L. (2003). *Exploring educational design: A snapshot of eight case studies using e-learning in Australian VET*. [n.l.]: Australian National Training Authority, Australian Flexible Learning Framework.

BBC. (2005). E-University 'disgraceful waste'. Retrieved March 14, 2005, from http://news.bbc.co.uk/1/hi/education/4311791.stm

Bennett, S., & Reilly, P. (1998). Using interactive multimedia to improve operator training at Queensland Alumina Limited. *Australian Journal of Educational Technology*, *14*(2), 75-87.

Biggs, J., & Moore, P. (1993). *The process of learning* (3rd ed.). NY: Prentice Hall

Billett, S. (1996). Towards a model of workplace learning: The learning curriculum. *Studies in Continuing Education*, *18*, *no.1*, 43-58.

Blaxter, L. C., Hughes, C., & Tight, M. (1996). *How to research.* Milton Keynes: Open University Press.

Bogdan, R. C., & Biklen, S. K. (1992). *Qualitative research for education: An introduction to theory and methods*. Boston: Allyn and Bacon.

Borg, W., & Gall, M. (1989). *Educational research: An introduction*. New York: Longman.

Brennan, R. (2003). "One size doesn't fit all": The pedagogy of online delivery in Australia. In H. Guthrie (Ed.), *Online learning: Research readings* (pp. 55-70). Adelaide: National Centre for Vocational Education.

Brennan, R., McFadden, M., & Law, E. (2001). *All that glitters is not gold: Online delivery of education and training*. Kensington Park, South Australia: National Centre for Vocational Education Research Ltd.

Brooker, R., & Butler, J. (1997). The learning context within the workplace: As perceived by apprentices and their workplace trainers. *Journal of Vocational Education and Training, 49*(4), 487-507.

Burns, R. B. (2000). *Introduction to research methods* (4th ed.). Sydney: Longman.

Carlivati, P. A. (2002). e-Learning evolves. *ABA Banking Journal.* Retrieved March 10, 2005, from http://www.ababj.com/elearnevolves.html

Cashion, J., & Palmieri, P. (2002). *The secret is the teacher: The learner's view of online learning.* Kensington Park, South Australia: National Centre for Vocational Education Research Ltd.

Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L. B. Resnick (Ed.), *Knowing, learning and instruction: Essays in honour of Robert Glaser* (pp. 453-494). Hillsdale, N.J.: Erlbaum.

Cook, L. K., & Mayer, R. E. (1988). Teaching readers about the structure of scientific text. *Journal of Educational Psychology, 80,* 448-456.

Coyne, P. (2002). Interview. *The Knowledge Tree: An e-Journal of Flexible Learning in VET, 3* Retrieved May 30, 2006, from http://www.flexiblelearning.net.au/knowledgetree/edition03/html/int_peterCoyne.html

Dallow, J. (2005, March). *Blogs and wikis for trainers.* Paper presented at the Australian Institute of Training and Development Seminar, Canberra.

Davies, J. A. (2002). *Assessing and predicting information and communication technology literacy in education undergraduates*. Alberta, Canada: UMI - PhD Dissertations Publishing.

Davies, L. (2002). Interaction: The critical next step for corporate e-learning. In E. McKay (Ed.), *2002: International best practice to improve corporate performance* (pp. 56-75). Melbourne: RMIT Publishing.

Debande, O. (2004). ICTs and the development of eLearning in Europe: The role of the public and private sectors. *European Journal of Education, 39*(2), 191-208.

Denzin, N. K. (1994). The art and politics of interpretation. In Denzin N. & Lincoln Y. (Eds.), *Handbook of qualitative research* (pp. 500-516). Thousand Oaks: Sage.

Dineen, S. (2005). E-learning take-up will leap ahead once the SMEs log on. *Personnel Today* Retrieved February 25, 2005, from http://www.personneltoday.com/Articles/2005/01/18/27495/E-learning+take-up+will+leap+ahead+once+the+SMEs+log.htm

Driscoll, M. P. (2002). How people learn (and what technology might have to do with it). Retrieved April 24, 2006, from http://www.ericdigests.org/2003-3/learn.htm

Dyer, W. G., & Wilkins, A. L. (1991). Better stories, not better constructs, to generate better theory: A rejoinder to Eisenhardt. *Academy of Management Review, 16*(3), 613-619.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review, 14*(4), 532-550.

Eisner, E. (1979). *The educational imagination*. New York: Macmillan.

Eklund, J., & Kay, M. (2002). *Strategy 2001: Evaluation of the usage of national Flexible Learning Toolboxes (Series 2)*. n.l.: Australian National Training Authority.

Eklund, J., & Kay, M. (2003). *Evaluation of the usage of national Flexible Learning Toolboxes (Series 3)*. [n.l.]: Australian National Training Authority.

Eklund, J., Kay, M., & Lynch, H. M. (2003). e-Learning: Emerging issues and key trends. *The Knowledge Tree: An e-Journal of Flexible Learning in VET, 4.* Retrieved June 15, 2006, from http://www.flexiblelearning.net.au/knowledgetree/edition04/pdf/elearning250903final.pdf

Ellis, R. (2004). Down with boring e-learning: An interview with Dr. Michael Allen. Retrieved January 25, 2005, from http://www.learningcircuits.org/2004/jul2004/allen.htm

Galagan, P. A. (2001). Mission e-possible: The Cisco e-learning story - Cisco Systems Ltd. uses electronic training. *T+D, 55*(2), 46-56.

Garrison, D. R., & Anderson, T. (2003). *E-Learning in the 21st Century: A framework for research and practice*. London: RouteledgeFalmer.

Goos, M. (2006). Creating learning spaces. In P. Grootenboer, R. Zevenbergen & M. Chinappan (Eds.), *Identities, cultures and learning spaces (Proceedings at the 29th annual conference of the Mathematics Education Research Group of Australasia)* (pp. 3-14). Adelaide: MERGA.

Guba, E., & Lincoln, Y. (1981). *Effective evaluation*. San Francisco: Jossey-Bass.

Harper, B., Hedberg, J., Bennett, S., & Lockyer, L. (2000). *Review of research - The on-line experience: The state of Australian on-line education and training practices*. Kensington Park, SA: NCVER.

Harris, R., & Volet, S. (1996, October). *Developing competence through work-based processes and practices: A case studies approach.* Paper presented at the third annual ANTARAC conference, Melbourne.

Harvey, K. (2005). Mastering the distance: Kathy Harvey talks to James Fleck about his plans for global expansion of the Open University. Retrieved March 15, 2005, from http://education.independent.co.uk/low_res/story.jsp?story=602476&host=16&dir=371

Herrington, J., Oliver, R., & Reeves, T. (2003). Patterns of engagement in authentic online learning environments. *Australian Journal of Educational Technology, 19*(1), 59-71.

Hill, R., Malone, P., Markham, S., Sharma, R., Sheard, J., & Young, G. (2003). *Researching the size and scope of online usage in the vocational education and training sector*. Leabrook, SA: Australian National Training Authority.

Hobbs, D. L. (2002). A constructivist approach to web course design: A review of the literature. *International Journal on E-Learning, 1*(2), 60-65.

Hollingsworth, S., & Socket, H. (Eds.). (1994). *Teacher research and educational reform*. Chicago, IL: The University of Chicago Press.

Houlden, J., & Houlden, W. (1999). *Best practice in online delivery*. Sydney: NSW Department of Education and Training.

Hung, D., & Nichani, M. (2001). Constructivism and e-learning: Balancing between the individual and social levels of cognition. *Educational Technology Review* (March-April), 40-44.

Jonassen, D., Peck, K., & Wilson, B. (1999). *Learning with technology: A constructivist perspective*. Upper Saddle River, NJ: Prentice Hall.

Jonassen, D., & Tessmer, M. (1996). An outcomes-based taxonomy for instructional systems design, evaluation and research. *Training Research Journal, 2*, 11-46.

Jones, K., & Byrnes, J. (2006). Characteristics of students who benefit from high-quality mathematics instruction. *Contemporary Educational Psychology, 31*(3), 328-343.
Kim, K. J., Bonk, C. J., & Zeng, T. (2005, June). Surveying the future of workplace e-learning: The rise of blending, interactivity, and authentic learning. *E-Learn Magazine*.
Lincoln, Y., & Guba, E. (1985). *Naturalistic inquiry*. Thousand Oaks, CA: Sage.
Manning, B. H., & Payne, B. D. (1996). *Self-talk for teachers and students: Metacognitive strategies for personal and classroom use*. Boston: Allyn and Bacon.
Mathison, S. (1988). Why triangulate? *Educational Researcher, 17*(2), 13-17.
Mayer, R. E. (2001). *Multi-media learning*. Cambridge: Cambridge University Press.
Mayer, R. E., Dow, G. T., & Mayer, S. (2003). Multimedia learning in an interactive self-explaining environment: What works in the design of agent-based microworlds? *Journal of Educational Psychology, 95*(4), 806-813.
Merriam, S. B. (1985). The case study in educational research: A review of selected literature. *Journal of Educational Thought, 19*(3), 204-217.
Merriam, S. B. (1988). *Case study research in education: A qualitative approach*. San Francisco: Jossey-Bass.
Merriam, S. B. (1998). *Qualitative research and case study applications in education. (Revised and expanded from case study research in education)*. San Francisco: Jossey-Bass.
Mildon, F. (2000, November). *Successful delivery of web based e-learning.* Paper presented at the NET*Working 2000, Keynote, [Online]. Retrieved March 15, 2005 from http://www.flexiblelearning.net.au/nw2000/main/key02.htm.
Moyer, L. G. (2002). Is digital learning effective in the workplace? Retrieved February 9, 2006, from www.elearnmag.org/subpage.cfm?section=research&article=2-1
Neuman, W. L. (2003). *Social research methods*. Boston: Pearson Education.
Newton, D., & Hase, S. (2002). 'How can you learn to drive a dozer online?' Moving to online learning in the mining industry, *Proceedings Moving Online II: A Conference to explore the challenges for workplaces, colleges and universities* (pp. 190-204). Gold Coast: Southern Cross University.
O'Fathaigh, M. (2002, March). *E-Learning and access: Some issues and implications.* Paper presented at the UACE Conference, University of Bath.
Oliver, R. (2001). Seeking best practice in online learning: Flexible Learning Toolboxes in the Australian VET Sector. *Australian Journal of Educational Technology, 17*(2), 204-222.
Oliver, R., & Blanksby, V. (2003). Online learning designs in the training sector. In G. Crisp, D. Thiele, I. Scholten, S. Barker & J. Baron (Eds.), *Interact, integrate, impact: Proceedings of the 20th annual conference of the ASCILITE* (pp. 364-374). Adelaide: ASCILITE.
Ossipoff, M. (2001, November). *Technology and the future.* Paper presented at the NET*Working 2001 Conference (Keynote), Brisbane.
Palmieri, P. (2003). *The agile organisation: Case studies of the impact of flexible delivery on human resource practices in TAFE*. Adelaide, SA: NCVER, Australian National Training Authority.
Patton, M. Q. (1990). *Qualitative evaluation and research methods* (2nd ed.). Newbury Park: Sage.

Peters, C., & Lloyd, C. (2003). *Differentiating needs: Customer demand for online training*. Kensington Park: National Centre for Vocational Education Research Ltd.

Piaget, J. (1963). *Origins of intelligence in children*. New York: Rinehart & Wineston.

Pittard, V. (2004). Evidence for e-learning policy. *Technology, Pedagogy and Education, 13*(2), 181-194.

Ramsden, P. (1988). Context and strategy: Situational influences on learning. In R. Schmeck (Ed.), *Learning strategies and learning styles* (pp. 159-184). New York: Plenum.

Reeves, T. (1999a). Effective dimensions of interactive learning on the World Wide Web. In B. Khan (Ed.), *Web-based instruction* (pp. 59-66). Englewood Cliffs, NJ: Educational Technology Publications.

Reeves, T. (1999b, June). *A research agenda for interactive learning in the new millennium.* Paper presented at the World Conference on Educational Multimedia, Hypermedia and Telecommunications, Seattle.

Reid, A. (1992). Computer management strategies for text data. In B.F. Crabtree & W. L. Miller (Eds.), *Doing qualitative research* (Vol. 3). London: Sage.

Ring, G., & Reeves, T. (2002). Impact evaluations of corporate elearning. In G. Richards (Ed.), *Proceedings of the World Conference on e-Learning in Corporate, Government, Healthcare and Higher Education.* (pp. 818-823). Chesapeake VA: AACE.

Rood, D. (2004, 15 November). Online universities fail to make the grade. *Sydney Morning Herald* Retrieved April 17, 2006, from http://www.smh.com.au/news/National/Online-universities-fail-to-make-the-grade/2004/11/14/1100384429986.html

Rosenberg, M. (2001). *Beyond e-learning*. San Francisco, CA: Pfieffer.

Rosenberg, M. (2005). *e-Learning: Building successful online learning in your organisation*. New York: McGraw Hill.

Salomon, G. (1991). Transcending the qualitative-quantitative debate: The analytic and systemic approaches to educational research. *Educational Researcher, 20*(6), 10-18.

Schofield, K. (2003). Think strategy: E-learning in four companies. In H. Guthrie (Ed.), *Online learning: Research readings* (Vol. 1, pp. 163-182). Kensington Park, South Australia: National Centre for Vocational Education Research Ltd.

Shulman, L. S. (1988). Disciplines of inquiry in education: An overview. In R. M. Jaeger (Ed.), *Complementary methods for research in education* (pp. 3-20). Washington: AERA.

Silberman, M. (Ed.). (2005). *2005 ASTD training and performance sourcebook.* Alexandria, Virg: ASTD Press.

Smart, L. (2002). Validated individual learning pathways. *The Knowledge Tree: An e-Journal of Flexible Learning in VET, 2.* Retrieved June 30, 2006, from http://www.flexiblelearning.net.au/knowledgetree/edition02/html/peer.html

Smith, P. J. (2000, March). *Preparing learners and workplaces in the effective use of flexible delivery for workforce training.* Paper presented at the AVETRA Conference, Canberra.

Smith, P. J. (2001). Learners and their workplaces: Towards a strategic model of flexible delivery of training in the workplace. *Vocational Education and Training, 53*(4), 609-628.

Smith, P. J., Wakefield, L., & Robertson, I. (2002). *Preparing for flexible delivery: Learners and their workplaces*. Kensington Park, South Australia: National Centre for Vocational Education Research Ltd.

Stake, R. E. (1994). Case studies. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 236-247). Thousand Oaks, CA: Sage.

Steed, C. (2001). Why e-learning is failing to convince the market. Retrieved February 26, 2005, from http://www.train-net.co.uk/news/full_news.cfm?ID=3140

Sturman, A. (1994). Case study methods. In T. Husen & T. N. Postlewaite (Eds.), *The international encyclopedia of education* (2nd ed., Vol. 2, pp. 640-646). London: Pergamon Press.

The Masie Center. (2003). *Making sense of learning specifications and standards: A decision maker's guide to their adoption*. (2nd ed.) Saratoga Springs NY: The Masie Center.

Thiagi, S. (2000, November). *Advice from an oxymoron.* Paper presented at the NET*Working 2000 Conference (Keynote), [Online] Retrieved November 22, 2004, from http://www.flexiblelearning.net.au/nw2000/summary/sum_key.htm#key1.

Tobin, K., & Fraser, B. (1998). Qualitative and quantitative landscapes of classroom learning environments. In B. J. Fraser & K. Tobin (Eds.), *The international handbook of science education* (pp. 623-640). Dordrecht, The Netherlands: Kluwer.

Valsiner, J. (1997). *Culture and the development of children's action: A theory of human development* (2nd ed.). New York: John Wiley & Sons Inc.

Vygotsky, L. S. (1978). *Mind in society; The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner & E. Souberman, Trans.). Cambridge, MA: Harvard University Press.

Waight, C. L., & Stewart, B. L. (2005). Valuing the adult learner in e-learning: Part two – insights from four companies. *Journal of Workplace Learning 17*(5/6), 398-415.

Wirski, R. M., Oliver, R., Hingston, P., Omari, A., & Brownfield, G. (2002). Considerations for a digital repository. *The Knowledge Tree: An e-Journal of Flexible Learning in VET, 1.* Retrieved March 17, 2006, from http://www.flexiblelearning.net.au/knowledgetree/edition01/html/peer1.html

Wonacott. (2002). The impact of work-based learning on students. *ERIC Digest, 242*.

Yin, R. (1994). *Case study research: Design and methods* (2nd ed. Vol. 5). London: Thousand Oaks.

Zenger, J., & Uehlein, C. (2001). Why blended will win. *T+D, 55*(8), 54-62.

APPENDIX A

Questionnaire – Apache Energy e-learning program

This survey contains statements about your experiences with the Apache Energy e-Learning Program. There are no "right" or "wrong" answers. Your opinion is what is wanted. Please think about how each statement relates to your experience. Be sure to tick just one response.

Background information

Language spoken at home	
Gender	

Do you have a computer at home?	
Do you have access to the Internet at home?	

Support	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1 I was provided with a good introduction to the program					
2 I knew what I had to do					
3 Responses to my enquiries were satisfactory					
4 I felt comfortable working in the e-Learning centre					
5 I felt rushed, working through the e-Learning program					
Any comments on the facilities and/or support provided?					
The program	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
6 The program was easy to navigate					
7 I enjoyed doing the quizzes					
8 The use of audio and visual material was engaging					
9 I found the real world examples valuable					
10 I think what I learnt will be useful in my role in the oil and gas industry					
Any comments on the content and structure of the e-Learning program?					
The tests	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
11 The "Check your Knowledge" test was too hard					
12 I felt comfortable about my basic knowledge of safety in the oil and gas industry after completing the "Check your knowledge" test					
13 The "Permit to Work" test was too hard					
14 I felt competent to be able to apply for a Permit to Work after completing the "Permit to Work" test					
Any comments on the tests?					
Autonomy and enjoyment	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
15 I felt in control of the learning process					
16 I worked at my own pace and level					
17 The activities in the e-Learning program relate to the real world					
18 I engaged in conversations about the e-Learning program with others at the facility					
19 I enjoyed working through the e-Learning program					
20 I would undertake this type of learning again					
What did you like most about the e-Learning program?					
What did you dislike most about the e-Learning program?					
Any other comments?					

Thank you for participating in this questionnaire.

APPENDIX B

Interview Questions (Participants)

Contractors (Apache Energy)

Focus on learner motivations, achievement of competency and depth of learning

No.	Category	Question	Past, Present, Future
1	Experience/ behaviour	Why are you doing the Apache e-Learning program?	Past
2	Experience/ behaviour	What were your initial thoughts about using the Apache e-Learning program? What did you expect to achieve?	Present
3	Experience/ behaviour	What was your main objective in using/doing the Apache e-Learning program?	Present
4	Experience/ behaviour	When you started using the program, were you interested in what you saw? Explain.	Present
5	Experience/ behaviour	Can you describe how you went about using the program and the sorts of things you did?	Present
6	Opinion/ value	Was passing the Check your Knowledge and Permit to Work tests important to you? Why/Why not?	Present
7	Opinion/ value	Did you find using the Apache e-Learning program satisfying? Explain.	Present
8	Opinion/ value	Would you recommend this program to your work mates? Why/Why not?	Future
9	Opinion/ value	In using the computer to learn, did you restrict yourself to what is required or did you go into extra areas (for instance, like real world examples)? Why?	Present
10	Experience/ behaviour	What was the main thing you learned from this program (if anything)?	Present
11	Opinion/ value	Do you believe that using the computer to learn has provided you with any extra knowledge than that which was expected? If yes, what?	Present
12	Opinion/ value	How would you feel about using a computer to learn in the future?	Future
13	Background	What is your age?	Present
14	Background	What is your highest qualification?	Present

Provide a blank sheet of paper and ask the question:

"Here is a blank piece of paper. Jot down or draw what you have learnt in using the e-Learning program."

Contractors (Apache Energy On return from the workplace)

Focus on relevance of content and collaboration

No.	Category	Question	Past, Present, Future
1	Opinion/ value	How relevant was the e-Learning program to your job when you got up to the facility?	Present
2	Opinion/ value	Did you talk about the e-Learning program with anyone up at Varanus/Stag? If so, what did you talk about and why?	Present

Experience/behaviour = 3;
Sensory = 1;
Knowledge = 1;
Opinion/value = 16;
Background = 2

APPENDIX C

Interview Questions (The e-Learning Centre)

No.	Category	Question	Past, Present, Future
1	Sensory	Describe what I would see if I were to walk into the e-Learning Centre to observe how the e-Learning program is used?	Present
2	Feeling	What is your feeling about e-learning in general?	Present
3	Opinion/ value	How do you perceive your role in the implementation of the Apache Energy e-Learning program?	Present
4	Opinion/ value	What is your perception of the *implementation* of the Apache Energy e-Learning program? Can it be improved?	Present/ Future
5	Experience/ behaviour	Do contractors interact with the e-Learning program on an individual basis or are there opportunities to collaborate with others? How important is collaboration in your view?	Present
6	Opinion/ value	What is your perception of the *design* of the Apache Energy e-Learning program? Can it be improved?	Present/ Future
7	Opinion/ value	To what extent do you think contractors are ready for e-learning?	Present
8	Opinion/ value	Have contractors enjoyed using the e-Learning program? Do they appear motivated by its attributes?	Past

Experience/behaviour = 3;
Sensory = 1;
Knowledge = 1;
Opinion/value = 16;
Background = 2

APPENDIX D

Interview Questions (Safety Advisers)

No.	Category	Question	Past, Present, Future
1	Opinion/ value	How effective is the Apache Energy e-Learning program as a learning tool for contractors?	Present
2	Feeling	What is your feeling about e-learning in general?	Present
3	Opinion/ value	How relevant is the content, embedded in the e-Learning program, both to contractors and the workplace?	Present
4	Opinion/ value	How authentic is the content, embedded in the e-Learning program, both to contractors and the workplace? Do you think that this level of authenticity affected engagement and motivation?	Present
5	Opinion/ value	How do you perceive your role in the implementation of the e-Learning program?	Present
6	Experience/ behaviour	Do contractors interact with the e-Learning program on an individual basis or are there opportunities to collaborate with others? How important is collaboration in your view?	Present
7	Opinion/ value	How comprehensive is the content of the e-Learning program in preparing learners for the Check your Knowledge and Permit to Work Tests?	Present
8	Opinion/ value	What is your perception of the design of the Apache Energy e-Learning program? Can it be improved?	Present
9	Opinion/ value	To what extent are contractors ready for e-learning?	Present
10	Opinion/ value	Have contractors enjoyed using the e-Learning program? Do they appear motivated by its attributes?	Past
11	Opinion/ value	Do you think that contractors have developed knowledge and/or skills in areas other than Safety as a result of engaging with the e-Learning program? If so, what knowledge and/or skills?	Present
12	Opinion/ value	To what extent does the e-Learning program provide opportunities for contractors to attain knowledge and skills in workplace safety that goes beyond what is required?	Present
13	Opinion/ value	If unplanned learning did occur as a result of engaging with the e-Learning program, do you think that this is useful to the performance of tasks in the workplace?	Present
14	Opinion/ value	Can the implementation of the e-Learning program be improved? If so, how?	Future
15	Opinion/ value	Do you think the e-Learning program should continue? Why? Why not?	Future
16	Opinion/ value	What is the ideal learning environment in your opinion?	Future

Experience/behaviour = 3; Sensory = 1; Knowledge = 1; Opinion/value = 16; Background = 2

APPENDIX E

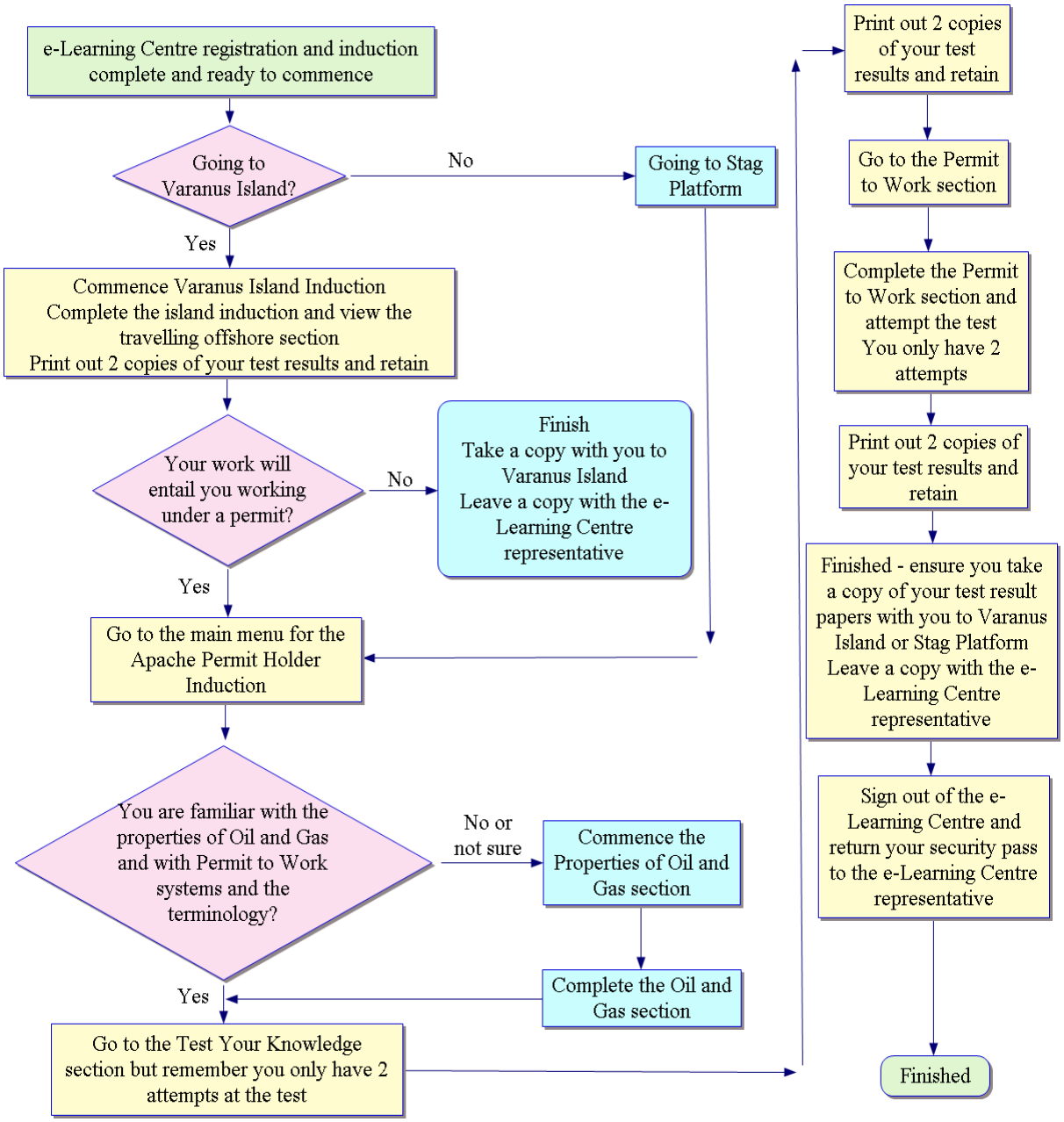
Interview Questions (Safety Manager)

No.	Category	Question	Past, Present, Future
1	Experience/ behaviour	Describe how you are using the Apache Energy e-Learning program? How was this strategy arrived at?	Past
2	Knowledge	What led Apache Energy to consider developing and implementing an e-Learning program in the first place?	Past
3	Opinion/ value	Do you feel that there is an organised and coherent strategy to e-learning at Apache Energy? Why/Why not?	Present
4	Opinion/ value	To what extent has senior management at the organization supported the implementation of the e-Learning program?	Past
5	Relative advantage	To what extent do you see e-learning as an enhanced learning solution? Is it better than the way in which safety knowledge was delivered in the past?	
6	Compatability	How compatible is e-learning with (a) existing skill sets of contractors? (b) With the learning culture generally at Apache Energy? And (c) with past experiences of staff at your organisation in dealing with change generally?	
7	Sensory	Describe what I would see if I were to walk into the e-Learning Centre to observe how the e-Learning program is used?	Present
8	Complexity	How user-friendly is the implementation of e-learning at Apache Energy? In relation to both staff and contractors?	
9	Opinion/ value	How do you perceive your role in the implementation of the e-Learning program?	Present
10	Opinion/ value	How do you think the staff will perceive this learning experience? Will they be positive or negative (or indifferent) about the e-Learning tool? Explain your thoughts.	
11	Experience/ behaviour	Do contractors interact with the e-Learning program on an individual basis or are there opportunities to collaborate with others? How important is collaboration in your view?	Present
12	Opinion/ value	What is your perception of the design of the Apache Energy e-Learning program? Can it be improved?	Present
13	Opinion/ value	What are your feelings about the way in which the e-Learning tool has been implemented? Has it been successful to date? Why/Why not?	Future
14	Opinion/ value	What is the ideal learning environment in your opinion?	Future

Experience/behaviour = 3; Sensory = 1; Knowledge = 1; Opinion/value = 16; Background = 2

APPENDIX F

Flowchart – e-Learning Centre



APPENDIX G

Results of James' Check your Knowledge and Permit to Work test scores

ANALYSIS OF DATA FOR APACHE ENERGY CHECK YOUR KNOWLEDGE AND PTW TESTS - 9 JUNE 2005

CHECK YOUR KNOWLEDGE

first_name	last_name	date_of_test	pass_fail	test_type	propertie	permit_	confined_att	isolations_a	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	a11	q12	q13
James		9/06/2005	pass	knowledge	2	1	1	1	4 of 4	3 of 3	4 of 4	5 of 5	5 of 5	3 of 4	5 of 5	5 of 5	3 of 3	6 of 6	4 of 4	4 of 4	1 of 2
X		9/06/2005	pass	knowledge	2	2	1	1	3 of 4	2 of 3	4 of 4	4 of 5	5 of 5	4 of 4	4 of 5	5 of 5	2 of 3	5 of 6	3 of 4	4 of 4	1 of 2
X		9/06/2005	pass	knowledge	2	2	1	1	4 of 4	3 of 3	4 of 4	5 of 5	5 of 5	4 of 4	4 of 5	5 of 5	3 of 3	6 of 6	3 of 4	4 of 4	1 of 2
X		9/06/2005	pass	knowledge	1	1	1	1	4 of 4	3 of 3	4 of 4	5 of 5	5 of 5	3 of 4	5 of 5	4 of 5	3 of 3	6 of 6	4 of 4	4 of 4	1 of 2
X		9/06/2005	pass	knowledge	1	1	1	1	3 of 4	3 of 3	4 of 4	5 of 5	5 of 5	3 of 4	5 of 5	4 of 5	3 of 3	6 of 6	4 of 4	4 of 4	1 of 2

pass
fail
did not attempt

James passed all items of the test

X passed all items of the test

PERMIT TO WORK

first_name	last_name	date_of_test	pass_fail	parta_attempts	partb_atte	partc_atte	test_type	part_a_q1	part_a_q2	part_a_q3	part_a_q4	part_a_q5	part_b_q1	part_b_q2	part_b_q3	part_b_q4	part_c_q1	part_c_q2
X		9/06/2005	fail				permit	8 of 8	3 of 3	3 of 3	4 of 6	3 of 3	3 of 3	2 of 4	2 of 3	3 of 3	4 of 4	6 of 6
James		9/06/2005	pass				permit	8 of 8	3 of 3	3 of 3	6 of 6	3 of 3	3 of 3	4 of 4	3 of 3	3 of 3	4 of 4	6 of 6
X		9/06/2005	fail				permit	7 of 8	3 of 3	3 of 3	6 of 6	3 of 3	3 of 3	4 of 4	3 of 3	3 of 3	4 of 4	6 of 6
X		9/06/2005	fail				permit	8 of 8	3 of 3	3 of 3	5 of 6	3 of 3	3 of 3	4 of 4	3 of 3	3 of 3	4 of 4	6 of 6
X		9/06/2005	fail				permit											

pass
fail
did not attempt

James passed part a, b and c of the PTW test

Summary
James performed well in both tests

X passed part c of the PTW test but has some issues with part a (signing a sa permit holder) and b (changing a permit)

Summary
X performed well in the Check your Knowledge test, but may have some knowledge gaps in the PTW system

X passed part b and c of the PTW test but failed part a due to not correctly completing the work to be done section of the PTW form

Summary
X performed well in the Check your Knowledge test, but may have a knowledge gap in the work to be done component of the PTW form

X passed part b and c of the PTW test but failed due to getting one sub question of q4 incorrect (signing as a permit holder)

Summary
X performed well in the Check your Knowledge test, but may have a knowledge gap in the signing as a permit holder component of the PTW form

X did not attempt the PTW test

Summary
X performed well in the Check your Knowledge test and did not attempt the PTW test

APPENDIX H

Results of Robert's Check your Knowledge and Permit to Work test scores

ANALYSIS OF DATA FOR APACHE ENERGY CHECK YOUR KNOWLEDGE AND PTW TESTS - 13 JUNE 2005

CHECK YOUR KNOWLEDGE

first_ name	last_ name	date_of_ test	pass _fail	test_ type	prope rties_	per mit_	confin ed_att	isolati ons_a	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	a11	q12	q13
rate									3	3	3	4	5	3	4	4	2	5	3	3	2
X		13/06/2005	fail	knowledge	2	2	1	1	2 of 4	2 of 3	4 of 4	5 of 5	5 of 5	3 of 4	4 of 5	4 of 5	3 of 3	6 of 6	4 of 4	3 of 4	1 of 2
X		13/06/2005	fail	knowledge	2	2	1	1	4 of 4	2 of 3	3 of 4	4 of 5	5 of 5	2 of 4	3 of 5	4 of 5	3 of 3	5 of 6	4 of 4	4 of 4	1 of 2
Robert		13/06/2005	fail	knowledge	1	2	2	1	4 of 4	3 of 3	4 of 4	5 of 5	5 of 5	2 of 4	5 of 5	3 of 5	3 of 3	4 of 6	3 of 4	4 of 4	1 of 2

pass
fail
did not attempt

X passed all items of the test except for q1 (Control of oil and gas) and q2 (Flammability). Overall he scored 86% in the

X passed all items of the test except for q2 (Flammability), q6 (Permit to Work) and q7 (Why a Permit to Work). Overall he scored 82% in the test.

Robert passed all items of the test except for q6 (Permit to Work) and q8 (When do you need a Permit to Work) and q10 (What is a confined space). Overall he scored 86% in the test.

PERMIT TO WORK

first_ name	last_ name	date_of_t est	pass _fail	parta_att empts	partb _atte	partc _atte	test_t ype	part_ a_q1	part_ a_q2	part_ a_q3	part_ a_q4	part_ a_q5	part_ b_q1	part_ b_q2	part_ b_q3	part_ b_q4	part_ c_q1	part_ c_q2
X		13/06/2005	fail	2	2	2	permit	8 of 8	2 of 3	3 of 3	5 of 6	2 of 3	2 of 3	3 of 4	1 of 3	3 of 3	4 of 4	4 of 6
Robert		13/06/2005	fail	2	2	2	permit	8 of 8	3 of 3	3 of 3	6 of 6	3 of 3	2 of 3	2 of 4	2 of 3	3 of 3	4 of 4	6 of 6
X		13/06/2005	fail	2	2	2	permit	8 of 8	3 of 3	3 of 3	5 of 6	3 of 3	3 of 3	3 of 4	3 of 3	3 of 3	4 of 4	6 of 6

pass
fail
did not attempt

X passed Part C of the test. On Part A he returned one incorrect answer (question 4, Signing as a permit holder) and on Part B he returned one incorrect answer (question 2, Change

X failed all aspects of the test. Overall his score was 80%

Robert passed Parts A and C of the test, but failed Part B questions 1 (signing as a permit holder), 2 (change of permit and 3 (precautions and gas testing). Overall his score was 91%.

Summary
X may have some knowledge gaps in the area of control of oil and gas and aspects of the PTW system, particularly signing and changing a permit

Summary
X may have knowledge gaps in the PTW system

Summary
Robert may have some knowledge gaps in the PTW system, particularly signing as a permit holder, changing a permit and precautions and gas testing